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DEVOTED EXCLUSIVELY TO THE INTERESTS OF ELECTRIC LIGHTING AND POWER STATIONS

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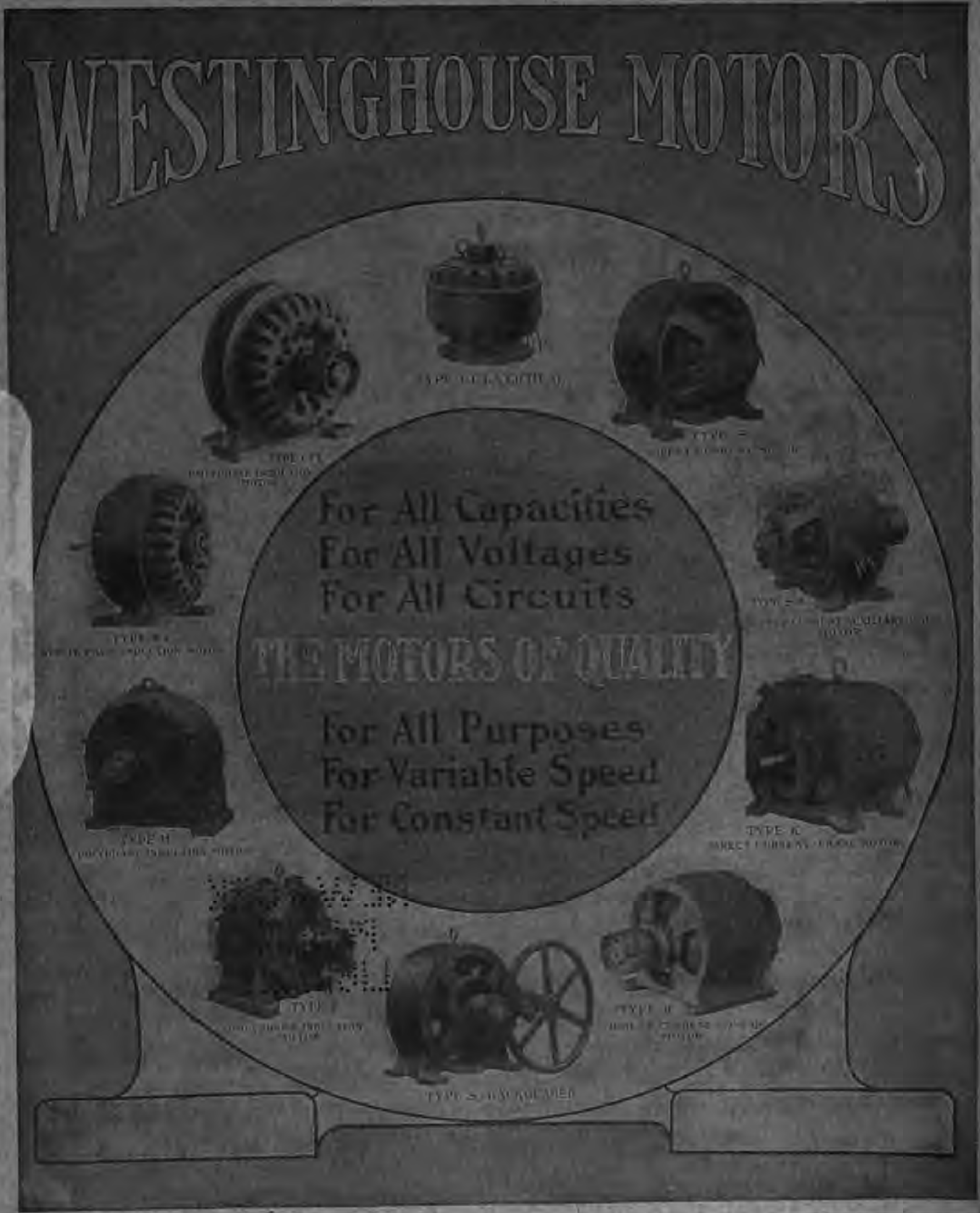
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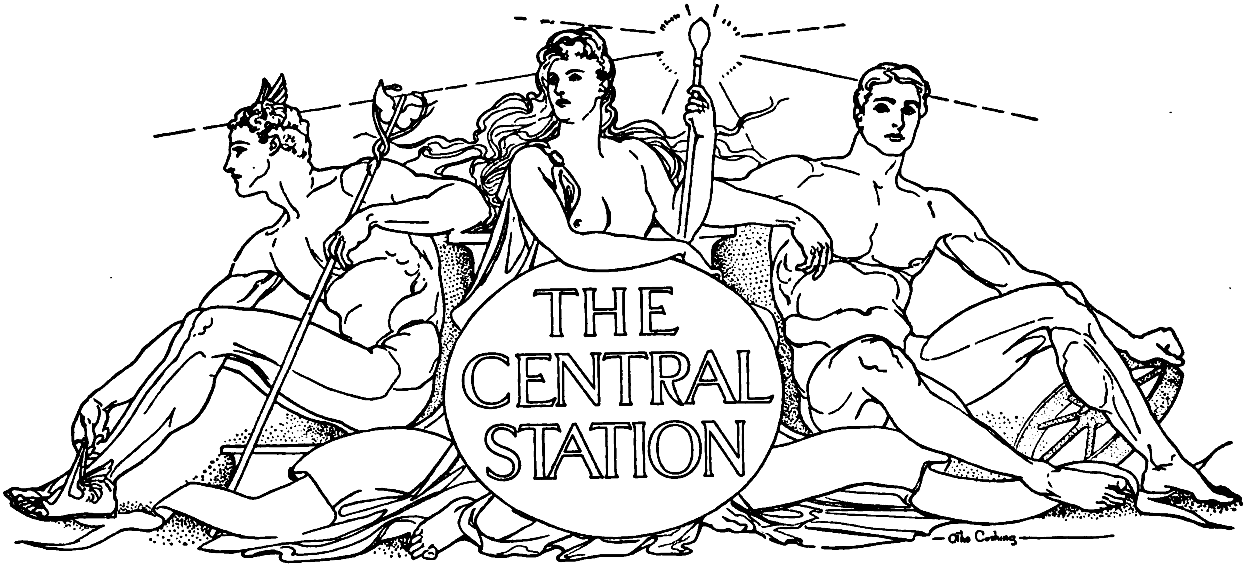

DEVOTED EXCLUSIVELY TO THE INTERESTS OF ELECTRIC LIGHTING AND POWER STATIONS.

VOL. 6, No. 1 NEW YORK, JULY, 1906. ISSUED MONTHLY.

Central Station Light, Heat and Power Principles

BY NEWTON HARRISON.

What Elements Deteriorate.—The complete plant combines within itself such elements as the boiler, engine, generator, switchboard and outside accessories, such as lines, poles, insulators and transformers. Of all of these, the wear and tear is most apparent in the boiler room, in the outside lines, poles and insulators, and in the lamps employed. The first cost of an installation is therefore subject to an item of annual depreciation, due to the stress and strain of service. The question arising in connection with central station equipments is the extent to which depreciation ensues, and in what manner it may be limited. In order to survey the situation from this standpoint, the elements constituting the plant must be examined consecutively, beginning with the boiler.

Depreciation of the Boiler.—The boiler, whatever its type may be, is subjected constantly to the influence of expansion and contraction, to the ill effects of impure water or water containing incrusting salts, to an internal pressure that is constantly testing its integrity (Fig. 1), and to the deteriorative influence of an intense heat upon the part where the water is more directly heated than elsewhere. As a result of this combination, in which one at least is acting destructively when the others are quiescent, the boiler does not remain normal for any great length of time. There appear in connection with it, not only the shut-down for repairs or cleaning, but the cash loss due to its non-service and the cash expense for extra labor. Boiler cleaning and repairs, therefore, in addition to the inevitable and final destruction that ensues, constitute depreciation. A boiler costing a certain sum to purchase also costs a certain sum annually to keep in running order. If, for instance, a boiler costs $1,000, and is cleaned and repaired each year for ten years at a cost of $100, the total expense for both boiler and attention of this character amounts to $2,000. If, however, another boiler, costing the same amount, represents a cost for cleaning and repairs during a ten year period of only $500, the gain is obvious. But this is not all that is to be considered in this respect. The efficiency of each respectively must enter into all calculations which involve items of this kind. There is the possibility of one boiler having 10 or 20 per cent. more efficiency than the other. In such a case, the cost of coal in one as compared with

the other, while producing the same number of pounds of steam determines the selection. Repairs and cleaning may be less, but the waste of fuel may be greater in one than the other, and therefore the cost of one boiler in comparison with the other may show a far greater annual expense.

Efficiency and Coal Bill.—To crystallize these ideas, the same case may be taken, that of two boilers costing $1,000 a piece, one meaning an expense at the end of ten years of $1,000 and the other only $500. If the boiler representing the $500 expense is less efficient than the other, then the dif-

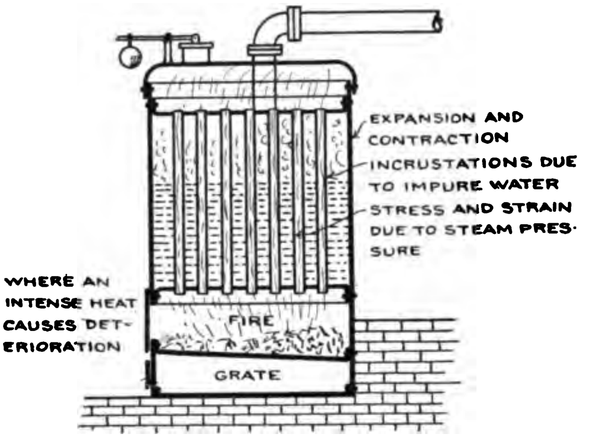

FIG. I. SOME OF THE ELEMENTS OF DEPRECIATION IN A BOILER.

ference in this respect must be noted. Suppose they vary as boilers to the extent of 10 per cent. in efficiency, then if one boiler burns 1,000 tons of coal (Fig. 2) a year, the other boiler burns 1,100 tons. At the end of 10 years one has burnt 10,000 tons of coal and the other 11,000. One boiler has therefore sent up in smoke 1,000 tons of coal, costing, roughly, $3,000, or one boiler has actually cost $300 a year more than the other. Efficiency may

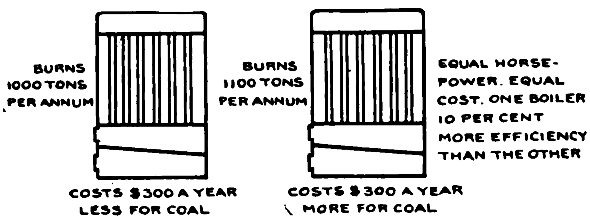

FIG. 2. TWO BOILERS OF EQUAL CAPACITY BUT DIFFERENT EFFICIENCIES COMPARED.

thus be recognized, commercially, as another name for annual expense, and in this respect must be recognized as a vitally important element to consider in connection with boilers, either annually or as pointed out, as part of the total expense of operation.

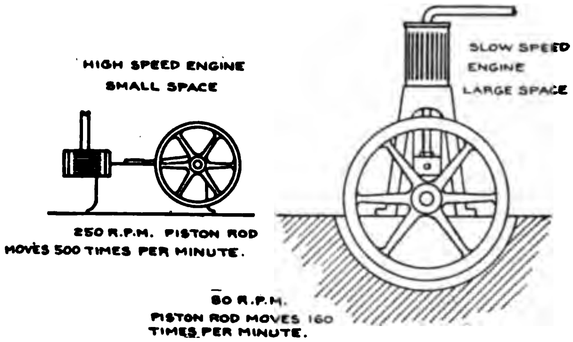

FIG. 3. COMPARISON OF HIGH AND LOW-SPEED ENGINES.

Coal and Depreciation.—Another point of importance to consider in connection with boilers is the fact that for boilers of equal capacity the one burning the most coal is, on general principles, the one that will wear out the soonest. Depreciation is therefore related to the amount of fuel consumed in the sense that it affects the durability ultimately to the extent also of shortening the period of useful-

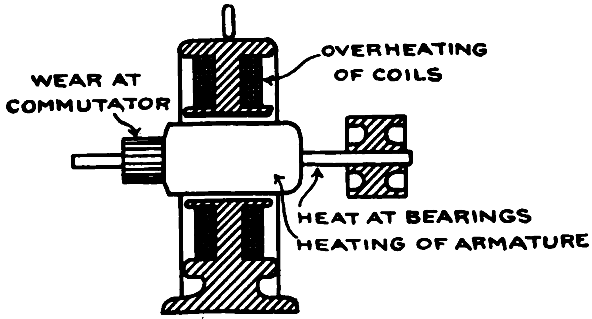

FIG. 4. SECTION OF A GENERATOR SHOWING THE POINTS OF WEAR AND DETERIORATION.

ness. In other words, the greater the amount of service to which a given machine is put, the greater the wear of the said machine. Although a boiler wears through other influences, as previously stated, the effect of the fire is found in the necessity for renovation at this point depending upon the heat, the fuel and the wear this severely used part is capable of.

Wear of the Engine.—A steam engine wears in proportion to the speed of its moving parts. As a corollary to this, it may be perceived that a slow-

moving engine will outwear a high speed engine in the ratio of two or three to one. But a slow-moving engine (Fig. 3) requires much more space than one of a higher speed, thus making it evident that for plants situated in a large city the slow speed engine must be made to occupy as little floor space as possible, a thing only attainable by setting the engine on end as it were; that is, by making a vertical type of it. A high-pressure high-speed engine wears and breaks, and represents expense to a far greater de-

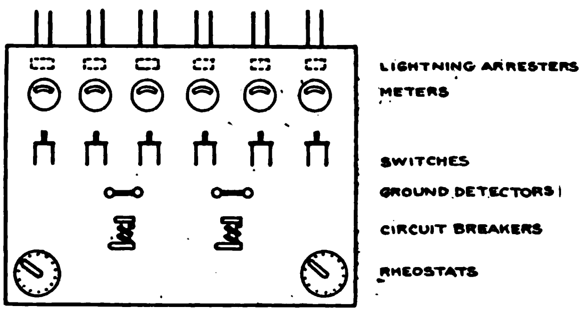

FIG. 5. SWITCHBOARD APPARATUS.

gree than a large slow-moving Corliss doing an equal amount of work. Their efficiencies do not vary greatly, so that the final question is largely that of space and its expensiveness.

Depreciation of the Generator.—The generator wears less than any device employed in central station work. It wears less because as a mechanical proposition it consists of a revolving mass of not very great weight, rotating on a shaft supported by two bearings. The neglect of the bearings is obviated by their self-oiling qualities. Thus the generator from this standpoint is of the simplest possible character without any reason for mechanical wear. The commutator in a direct current generator is the weak point (Fig. 4) in all cases. In an alternator there may or may not be collector rings. If not, no wear can possibly occur of any importance, as a mechanical fact. But if collector rings are employed the wear is so nominal as to be hardly worthy of reference. In a direct current machine, however, the wear is both mechanical and electrical at the commutator, though purely electrical at the windings.

The Commutator and Windings.—The commutator slowly wears away due to the friction of the brushes; it is also excoriated by the effects of sparks due to overload or a poor position of the brushes. The mechanical wear cannot be remedied, and is in the average case not severe enough to need particular attention. But a constant overload, or an inherent and unchangeable defect in the design, may cause a destructive sparking at the commutator, and rapidly destroy it. This was of frequent occurrence in the early days of electric lighting, but not to-day. Still it is the one salient element of depreciation in a generator that must be kept in mind. As far as the windings are concerned, excessive heating will ultimately clear their insulation, and ground and short-circuits make short work of the machine as a working element of the plant. Depreciation from this cause can be regulated at will, though in some instances, the inadequacy of the plant may make this impossible. In such cases, the cost of operating a generator may represent a bill of itemized expenses including "shutdowns" of serious aspect.

The Switchboard Expense.—At the switchboard the various circuits of primary importance are centered. The amount of power consumed, and the current and pressure of every important line is noted at this point. The meters for indicating the power and its elements (Fig. 5) and the devices that protect the circuits from overflows, grounds and lightning, find their place here. The wear and tear is

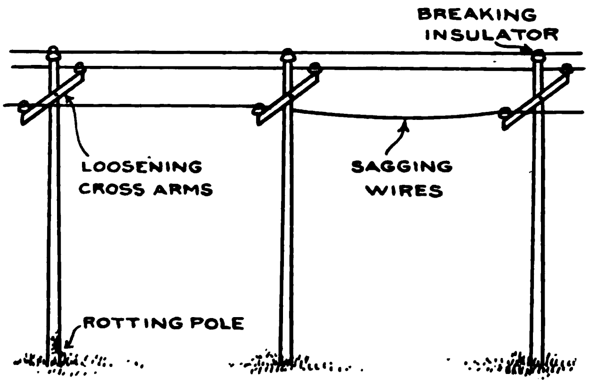

FIG. 6. DEPRECIATION IN A POLE LINE AND INSULATORS.

not great, but the risks, it might be said, are all centered there. These risks are those of inoperative circuit breakers, defective fuses, lightning discharges and static discharges from cables. The entire destruction of the switchboard may be brought about through fire; but even the fire, if due to lightning, as it generally is in central stations, is due to defective lightning arresters. Switchboard expense may be nil for a certain period, then the result of neglect, or the installation of second rate apparatus on the switchboard will be in evidence with sur-

prising suddenness, when conditions are propitious. But it may be said with certainty that under ordinary conditions the switchboard with its appliances, requires a minimum of attention. The cost at this point may be that of recalibrating instruments or renewing switches; otherwise the only other expense is that of the power wasted in the bus-bars when they are either overloaded or have been so limited in capacity originally that the normal output is the cause of a constant and useless waste of power.

Line Depreciation.—That which is called line depreciation includes what might better be called line, pole and insulator depreciation. Reference is here made to outside lines, though in city installations the lines underground and the conduits are items of fixed expense. But it is readily evident that poles rot and fall (Fig. 6), that lines sag and cross, and that insulators are bound to loosen, fall and break to some extent. Where there are high tension lines these facts are always in evidence to a greater or less degree. An installation of this character, therefore, in constantly associated with a fixed running expense for renewals and repairs. A severe storm or continued rain may mean temporary disablement, as has been shown in several instances in the west. Such depreciation cannot be estimated in percentages, but it may be realized that the amount of renovation will be to a large extent proportional to the climatic conditions existing, as well as the character of the pole and line work originally installed.

Lamp Depreciation.—Coal is an item that is expected to represent a constant expense, and the same may be said primarily of incandescent and secondarily of arc lamps. After 600 or 700 hours incandescent lamps must be renewed. After a few years of service arc lamps require overhauling or substitution. In either case, a fixed expense attaches itself to them both, and the depreciation, therefore, may be considered as regards these items after a certain number of months have passed as 100 per cent. But their service is the ultimate service to which a light producing plant is devoted, and for that reason the cost of illumination, or the cost of current finally, is best summed up by a consideration of the total cost involved, as running expense and annual depreciation in the entire equipment.

Prepared for THE CENTRAL STATION by Colin P. Campbell, Attorney.

Contributory Negligence of One Injured by Electric Current.

It appeared in evidence in this case that in September, 1902, George R. Martin, an employee as lineman of the Citizens' Electric Company was directed to put a cross-arm on one of its poles on Fifth street between Jefferson and Market. Right by this pole stood a pole of the Louisville Electric Light Company. The two poles were very close together at the bottom, so close that Martin could not get up between them. He went up the pole of the Louisville Electric Light Company. Both poles carried wires charged with deadly currents of electricity. On the pole of the Citizens' General Electric Company, and above its wires, the American District Telegraph Company had strung a wire, which was strung for telegraphing purposes and carried only a small amount of electricity, which was insufficient to hurt anyone. After Martin got up the pole of the Louisville Electric Company, he stood upon its cross-arm with one foot on or near the wire of that company and while standing in this

way in passing a rope, he threw his hand up and it came in contact with the wire of the telegraph company. Immediately he received a severe shock of electricity. His hand and foot were terribly burned, and he fell to the ground, suffering thus further injuries. He brought this action against all three of the companies. At the conclusion of the evidence the court instructed the jury peremptorily to find for the telegraph company, and the case being submitted to the jury as to the two electric light companies, they found a verdict for the defendant, and Martin appeals.

The proof was undisputed that the wire of the telegraph company was charged with only a few volts of electricity, and that it was in itself entirely harmless. It is said that perhaps this wire was crossed somewhere with some other wire, and had thus become charged with a deadly current of electricity. But this is pure speculation, and there is nothing in the record to show that the telegraph company knew, or had any reason to suppose, that there was any danger in its wire. Its wire being harmless in itself, the telegraph company would not be responsible to a stranger if he was hurt by touching it, when the wire had become charged with electricity without its knowledge, or anything in the circumstances to put it on notice of the danger. The only reasonable inference from the proof is that Martin's foot was on the heavily charged wire of the Louisvillle Electric Light Company, and when he touched the other wire he completed the circuit. The electricity that burned his foot and his hand came from the heavily charged wire of the Louisville Electric Light Company. The only reason that he was not killed was that the insulation in part protected him from the deadly current of electricity which the wire carried. We therefore conclude that the peremptory instruction in favor of the telegraph company was correct.

On the whole record, we think it reasonably clear that the jury found for the defendants upon the ground that Martin was himself negligent in standing upon the pole of the Louisville Light Company, with his foot on the wire of that company, which he knew was charged with 2,000 volts of electricity. He knew the dangers of the situation. He could see the wires about him. He knew the danger of making a short circuit, and if he had not placed his foot on the wire of the electric company there would have been no danger in his throwing his hands about the other wires. He knew the danger of getting his hands on these wires when discharging his duties on the pole, and the jury evidently thought that he was negligent in standing on the arm of the Louisville Electric Light Company with his foot on its wire, when any movement of his hand might bring it in contact with some of the other wires about him. The evidence presented a question of fact for the jury, and we cannot disturb their finding on this question of fact.

Martin v. Citizens' General Electric Company, (Ky.) 92 S. W. Rep. 547.

Evidence Proper on Question of Contributory Negligence on Part of Employee.

A lineman was sent out to work on poles, the upper cross-arms of which carried telephone wires and the lower cross-arms of which carried electric light wires. The decedent had rested his weight on the fifth cross-arm from the top and was working on the wires about the fourth cross-arm. In doing this, his body came in contact with a live wire on the fourth cross-arm and caused his death.

The evidence adduced shows that the decedent was an experienced lineman and had knowledge of the dangers commonly incident to such employment in working in proximity to live electric wires of high potentiality. It appears that a conversation which he had on the morning on the day of the accident, at the power house with the superintendent in the presence of other workmen was partly elicited upon direct examination of some of defendant's witnesses. So far as shown, it was to the effect that the superintendent apprised decedent that in doing the work on the pole in question he must look out for and guard against the live wires carried on the cross-arms of the pole. Upon cross-examination of these witnesses, plaintiff's counsel propounded an inquiry as to whether the decedent in this conversation requested the superintendent to shut off the current while he performed the duties assigned to him at the point in question. Plaintiff offered also to prove all of this conversation in rebuttal of defendant's claim —to which proof was admitted—that decedent was fully warned of the danger, namely, that these wires were charged with a high potential current. It is claimed that if the whole conversation had been admitted, it would have tended to show that the decedent was informed by the superintendent that the current would be shut off. If the superintendent so informed him, it seems quite clear that it would

have been very material on the question of decedent's contributory negligence. For if he was so informed he had a right to assume that the wires were not charged with electricity at the time he worked among and on them, and he would not be guilty of a want of ordinary care in coming in contact with them as he did. The fact, where appears in evidence, that in the forenoon of the day the current was cut off to enable the decedent and other linemen to repair the wires, lends emphasis to the importance of this evidence as tending to show that he was free from contributory negligence, and that he had a right to assume that the current was cut off. The trial court ruled that the decedent was sufficiently warned of the danger and that he assumed the risk incident to it, and that, therefore, no actionable negligence was shown. It is manifest from the record that the verdict was directed upon the ground that, under the facts and circumstances disclosed by the evidence, it conclusively appeared that decedent had assumed the risk of all dangers incident to the alleged negligence. As above indicated, this is erroneous if he had been informed or was led to believe that the current would be cut off the wires with which he came in contact. The evidence, as to defendant's negligence in the respect charged is in conflict and permits of different reasonable inferences in support of the claims of either party, and it therefore presents a question to be determined by the jury.

Smith v. Milwaukee Electric Co., (Wis.) 106 N. W. Rep. 829.

The Law Relating to Electricity, Central Stations and Power Companies.

I

Foreword.

ELECTRICITY AND THE LAW.

The relation between electricity, persons engaged in its generation and distribution and the law is of very modern origin. The common law of England crystallized into form many centuries before the first experiments with electricity and the possibility of the application of these principles to this new manifestation of energy is but another evidence of the versatility of the law and that it may be adapted to the changing conditions of developing society. We say that the application of the law to electrical science is novel. It has been less than three decades; in fact a little more than a quarter of a century since the first case involving this application of legal principles to the operation of electrical currents was decided. The fact that the subject is novel is not, however, an evidence that it is not an important subject. The manifestation of force which we call the electrical current for convenience has wrought many changes in our lives, and with those changes questions have arisen which in some instances have been settled by judicial decisions, in other instances by legislative enactment; many questions yet remain unsettled, and it will doubtless be many years before the law with relation to electricity, electrical conductors, power stations and companies can be called an exact science. The importance of this field cannot be over-estimated, electrical railways are multiplying with astounding rapidity, the streams of the country are being harnessed to furnish power along radii many miles in length, rumors are current that but a short time will elapse before the steam railroads of the country will be "electrified" for passenger service. All this activity means an increase in this field, and magnifies the importance of legal principles controlling the generation and sale of electricity. This subject is not, however, a subject by itself, but bears an intimate relation to other branches of the law and like fundamental principles are applied to this branch as to those other branches.

PURPOSE OF THIS SERIES OF ARTICLES.

The writer understands that in these articles he is addressing readers not familiar technically with the legal nomenclature, nor with the derivation of its principles. The effort will therefore be made, so far as possible, to treat the subject from an elementary standpoint. To discuss principles and to show their derivation, not so much to lay down empirical propositions. It ought first to be borne in mind that the law is a reasonable thing: that the law is a science, and when we speak of law in this connection we mean the common law, not that which has been enacted by legislature. The courts proceed upon established lines, pursuing and applying principles honored many times by the observance of centuries. But always reasonable, always deducible from well known fundamental notions of right living, which have been maintained and have been recognized from time immemorial. There is, however, in this field which we are about to enter very little that can be called settled law. New phases are

constantly arising, decisions, and it is to these in the main that we must look for our law, are constantly multiplying. We will, however, endeavor to discuss the questions which have arisen relative to elementary principles so far as possible in this series of articles with a view not so much to obviate the necessity for the employment of legal counsel, but to direct at what times and under what circumstances such counsel is necessary and when it is not.

What is the law?

Law has been variously defined; perhaps as good a definition as any is to call it a rule of civil conduct. This may be amplified by the following statement that it is a rule of civil conduct, prescribing what is right and prohibiting what is wrong. No doubt some of our laymen would alter this into meaning that it is a rule of civil conduct prescribing what it deems to be right and prohibiting what it deems to be wrong. But suffice it to say that a good definition of what is law has not yet been stated, but these already suggested will answer our purpose. First, let us speak of the derivation of the law. We have in this country as well as in all English speaking countries, two systems, the common law and the statute law. The common law arose from early Anglo-Saxon pre-Norman customs in England, and was aided by judicial construction by the courts from the time of William the Conqueror up to the time of Elizabeth. At this time the legal principles became pretty well finished and settled. It is true many changes have been wrought since that time, and this common law, as we call it, has been altered and added to by the legislature, both in England and in this country subsequent to that time. So if now we wish to know what the law is, we seek first the statute which shows what the legislature has done, and afterwards we seek the decisions of the courts, stating what the common law is. A fundamental system of law in the United States is the Federal and the State Constitutions; these control and regulate the power of the legislature, but in the main in no way affect the common law. Another source of law which affects central stations and power companies is municipal ordinances. With these, owing to limits which must in reason be placed upon this series of articles, we may have but little concern owing to their variety. In the main, we will have to deal with court decisons, for this comprises by all comparisons the far greatest body of law, and owing to our system of recognizing precedents as binding, has equal force, in fact we may say greater force in many instances than the enactments of the legislature, since what the courts have said can never be unconstitutional.

ORGANIZATIONS AND FRANCHISES OF POWER COMPANIES.

Business in this field may be done by individuals, by partnerships, by partnership associations, limited, by limited partnerships or by corporations. The main distinction between these different forms lies in the liability of those who may be called the owners of the plant. If it is individual, the liability for debts, of course, falls upon the individual; if it is a partnership, the liability falls upon each partner for the whole; if it is a partnership association, limited, the liability rests upon the general partners or any one general partner; if it is a corporation the liability cannot exceed the investment of capital, unless by statutory special enactment. Hence, for this reason the corporate organization is preferable, and it may also be said to be preferable for another reason, namely, because the courts have in some cases hesitated to allow the power of eminent domain, that is, the power to appropriate lands of private parties for the use of others to others than corporations. It is therefore, better that those engaged in the generation and sale of electrical energy would be incorporated.

FRANCHISES.

It is also essential that an electrical company should have a franchise where it is desirous of placing conduits in streets and highways or across streets and highways, or desires to supply light or heat to residents of cities and villages, or desires to erect poles and string wires in highways or across highways. This is true because without the permission of the proper authorities no one has any right to use a street or highway for any purpose aside from the ordinary public travel.

Crocker-Wheeler Company, of Ampere, N. J., have recently placed on the market a sixe 83 D engine type generator with an output of 75 k.w., 275 r. p. m., 125 or 250 volt, and have in the past few days received from four power users, orders for six of the new generators. Negotiations are now under way for a number of these already popular machines for plants in different parts of the country.

I. Modern Central Stations.

Gas Engine Plants at Münster, in Westphalia, and Zeitz, Germany.

By Frank C. Perkins.

The series of articles under the head of "*Modern Central Stations*" will include illustrations and descriptions of up-to-date electric lighting and power stations in European and other foreign countries, as well as in America, the intention being to give such facts and data as will be good practical guides for central station managers and superintendents, the information being given from an absolutely disinterested engineering standpoint. It is the intention to take up central lighting and power stations of modern construction operated by gas engines, steam turbines and reciprocating steam engines of vertical and horizontal types, as well as hydro-electric plants and municipal stations operating in connection with destructor plants where waste city refuse is utilized for supplying electric current for lighting, power and railway service.

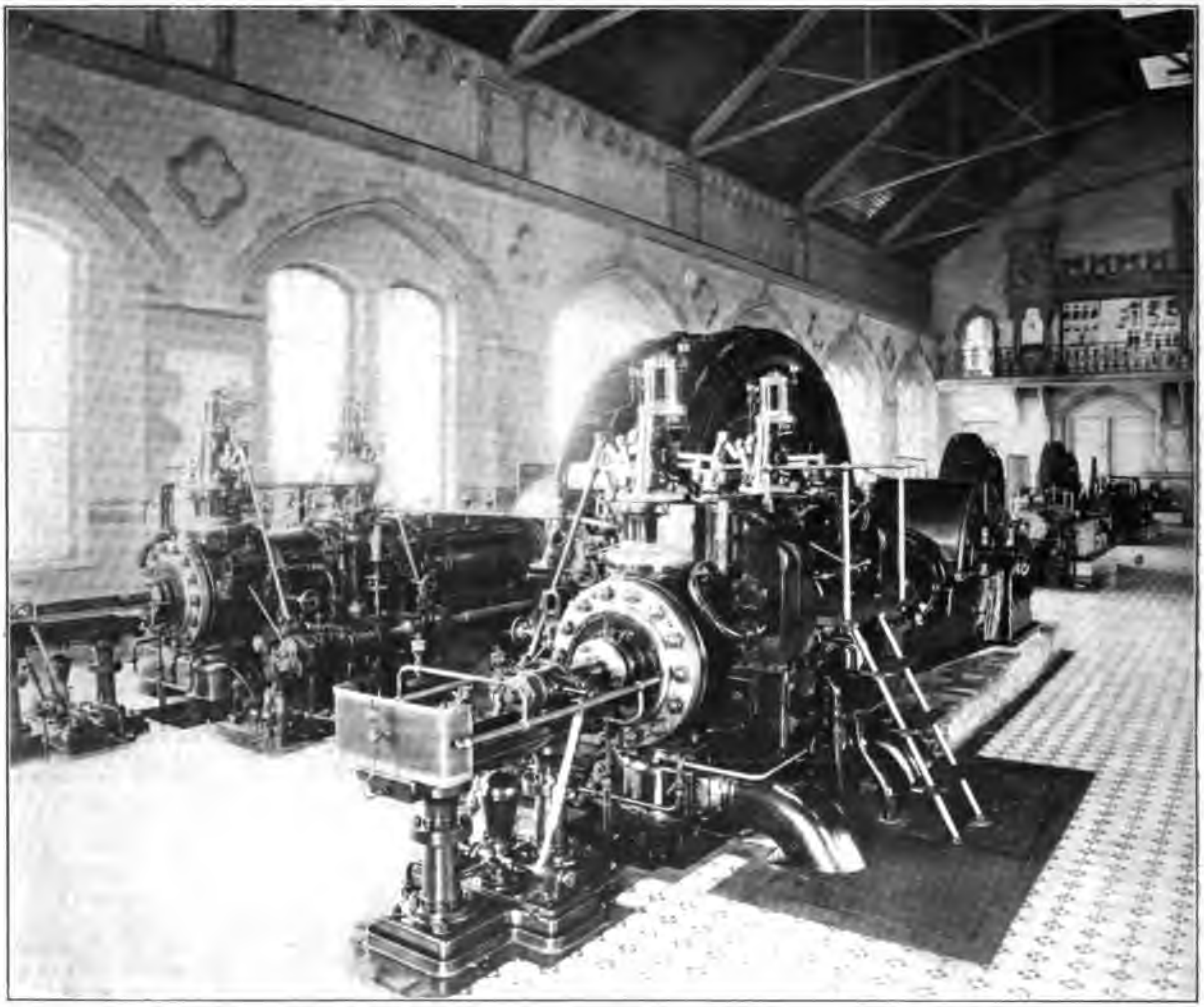

FIG. 1. 600-H.P. DOUBLE-ACTING TWIN GAS ENGINE IN MÜNSTER STATION.

The accompanying illustration (Fig. 1) is an excellent view of the interior of the engine and generator room of the Electricitäts-Werk, Münster, in Westphalia, Germany, this plant being equipped entirely with gas engines working on Dowson gas

The engine noted in the foreground is a 600 h. p. double-acting twin gas engine of recent design, directly coupled to an electrical generator constructed at Frankfort-on-the-Main, Germany, by the Elektricitäts-Aktien-Gesellschaft, formerly W. Lahmeyer & Co. There are five gas engine units in this plant having a capacity of 1,400 h. p. supplied with fuel from four gas producers, each having a capacity of 600 h. p. as a maximum.

The City of Münster in Westphalia is located in the northwestern part of Prussia, and has a population of 63,776. The City of Münster installed a municipal lighting and power plant using a direct current system with a storage battery plant as a reserve and for regulation, the distribution being carried out on the three-wire system.

The normal load on this station is about 600 kilowatts, and the storage battery plant has a normal capacity of 130 kilowatts. There are wired on the incandescent circuits in this German town 15,200 incandescent lamps of 50 watts each, and 422 arc lights of 10 amperes each.

The current is distributed to the consumers from this central station through 570 meters, which are not only utilized for measuring the current supplied for arc and incandescent lamps, but also for a large number of commercial direct current electric motors of a total capacity of 390 h. p., not including those utilized for electric street railway service.

The city electric station also supplies a direct current of 550 volts for operating the street railway, the current for lighting and power being distributed at 2x220 volts in connection with the accumulator plant.

There are two direct current-alternating current motor-generators also installed in this station, each having a capacity of 80 kilowatts. The current from the three-phase generators being transmitted at a pressure of 500 volts to five municipal electric pumping stations. The greatest distance to which the three-phase alternating current is transmitted is ten kilometers, which is about six and one-fifth miles, to the water-works furthest distant from the station.

The gas engines are arranged so that they may be operated either by the coke generator gas or from the city gas lighting mains as desired.

The plant is of particular interest as it shows

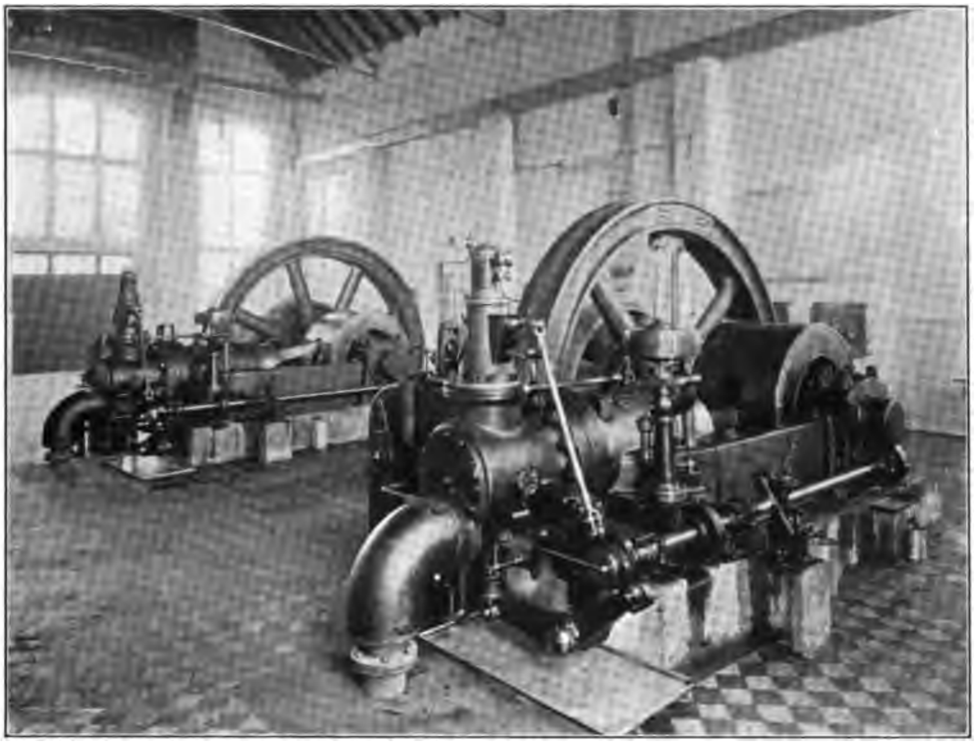

FIG. 2. GAS ENGINE AND GENERATOR ROOM OF ZEITZ STATION.

the latest up-to-date construction of a central station for moderate sized cities and towns, and indicates an ideal distribution of electric current over a small area, as well as very satisfactory load curves. The use of direct current on the three-wire system at 220 volts is satisfactory for the limited area of a small town, and the transformation of continuous current for transmission to a three-phase current, where electric power must be utilized ‿ distance for electric pumping is also ideal.

a day load which is very satisfactory, and gives an even load line for the 24 hours. This is of the greatest importance, and is sought for by the best electrical engineers, not only of modern central stations, but of hydro-electric power transmission systems throughout the world.

The ideal central station for city service would be one in which the lighting load at night can be offset during the day completely by a commercial load of electric motors, by a street railway load, and

FIG. 3. GAS CLEANING ROOM OF ZEITZ STATION.

by an electric-pumping plant which could be thrown into and out of service at a moment's notice for use only during the periods of light loads, the water being pumped into a reservoir of sufficient capacity so that the electric pumps may be idle during the peak of the central station load.

The use of electric power for pumping purposes in cities is coming into extensive use, and is a very satisfactory means of producing an even load line, as in many places large reservoirs are available into which electric pumps may force water during the day in periods of light loads, the pumps being shut down during the periods of heavy loads when the total amount of electric current may be utilized for lighting service.

The utilizing of current during the day for electric street railway service is also of importance, as at this German plant at Münster in Westphalia. which, taken in connection with the electric pumping plant and commercial motor service, produces

Another interesting German central station of somewhat smaller size using gas engine units with suction gas producers is that shown in the accompanying illustration (Figs. 2 and 3 and drawing Fig. 4), the latter showing the arrangement of the gas producer plant of the Elektrizitäts Werk der Stadt Zeitz. This plant of the Lignite Bricquet gas producer type has a capacity of 320 horse power.

The interior of the electric light station at Zeitz noted in Fig. 2 shows two gas engines of 160 horse power each, directly coupled to direct current generators. These engines operate at a speed of 160 revolutions per minute. The cylinders are 600 mm. in diameter and the stroke 780 mm. in length.

These engines are supplied with gas as above mentioned by a suction gas producer working on lignite coal, the consumption not exceeding 680 grams per effective horse power hour at full load, and at 75 per cent. of the full load the consumption is said not to exceed 800 grams per effective horse power hour, and not over 1,000 grams at half load, the percentage of ash not exceeding 13 per cent. At the Zeitz station it is stated the cooling water consumption for the engine does not exceed 50 liters per effective horse power hour.

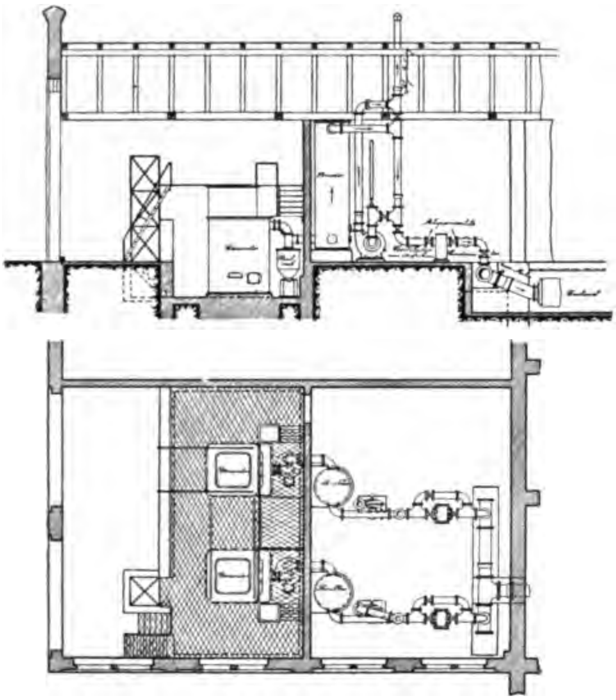

FIG. 4. PLAN OF GAS PRODUCER PLANT AT THE ZEITZ STATION.

During a recent test of this plant from eleven o'clock until 8.10 P. M., with a load of 111.3 k.w., or about 170 h. p. there was a consumption of 880 kilograms of bricquets or a consumption of .575 kg. per effective horse power hour, while the cooling water required was only 25 liters per effective h. p. hour, on another test from 9.30 to 6.30 P. M., with a load of 65.1 k. w., or about 102.8 effective h. p. there was a coal consumption of 550 kgs. of bricquets, or 6 kgs. per effective h. p. hour. During this test, which continued on the day following, it was found that with variation of load of 45 per cent. the speed changes did not exceed 1.53 per cent.

The little city of Zeitz is only one example of a number in Germany using producer gas for operating the central station for lighting and power service. It has a population of 27,391, and is provided with a direct current lighting and power distribution system with an accumulator plant for storing current during light load, the storage battery also acts as a regulator on the three wire circuit provided.

The total cost of this plant was 400,000 marks. It has been in operation for somewhat over a year, and is said to have given excellent satisfaction.

For lighting service the charge is 55 pfennig, while for power the current is sold at 25 pfennig, with a rebate up to 20 per cent. On the distribution circuit there are 197 meters installed supplying current to a number of commercial motors on the circuit of 2x220 volts, the total capacity being 180 h. p. In addition to the above-mentioned power load there the 3,100 incandescent lamps installed of 51 watts each and the storage battery has a normal capacity of 132 kilowatts.

There is every reason to believe that in America similar gas engine central stations will rapidly be installed in small towns and cities with great advantage. Heretofore belt driven gas engine plants have been more extensively employed in this country, but the wonderful development of the gas engine during the past decade, in this country as well as abroad, has made it possible not only to use direct connected gas engine units with great economy, but also to employ this type of prime mover without the excessively heavy fly wheels heretofore required in order to obtain good regulation. The double acting gas engine as well as the twin and tandem construction has made it impossible to greatly reduce the size of the fly wheel required on account of the greater number of impulses obtained by the use of these types over the ordinary four cycle single acting single cylinder engine heretofore employed almost exclusively.

At the Zeitz central station the gas engines are of the latter type, however, and have heavy fly wheels for aiding the regulation. These engines were built by the Gasmotoren-Fabrik Deutz of Koln-Deutz, while the electrical generators were constructed by the Allgemeinen-Elektrizitäts-Gesellschaft of Berlin, Germany.

The Central Station

ST. PAUL BUILDING,

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TELEPHONE, 3831 CORTLANDT.

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A Great Central Station Economy.

European engineers have ceased to criticize American practice, particularly where it relates to central station equipments. A tradition that certain European engineers were contemplating extensive experiments with gas engines and gas producing plants was once extant; but from tradition it rapidly became modern gospel and developed in an exceedingly short time into a coherent, definite and readily explainable practice, which left the experimental stage, at least, far behind. It is interesting to note the spontaneous development of an idea which at one time was regarded as but a suggestion of little weight or future importance. It is more than interesting to note the influence exercised imperceptibly by changes of practice, of a radical and far-reaching character which are bound to so affect the central station practice of to-day, and perhaps the entire future, that to some, mention of it would appear superfluous. Yet the advent of the gas engine and gas producer plants in the electric lighting field is not entirely what it should be to those to whom such information must be valuable. A certain firm of manufacturers in the United States have already manufactured and sold more than 150,000 horse power of such plants. On a basis of this kind, a few figures will prove interesting and instructive. It has been conservatively estimated that a saving of over 50 per cent. in fuel is directly possible by gasifying it, and using the gas in a gas engine instead of the customary boiler and engine. In other words, where formerly twice as much fuel was once used, or would have been used to produce 150,000 horse power, now only the fuel required for 75,000 horse power is giving the 150,000 horse power quota under these changed conditions. We are a nation to whom fuel is so plentiful and in certain respects so cheap, that the saving of it has not appealed to us as much as it should. But a change of opinion is gaining ground in favor of less consumption of fuel for a given power return, and more efficiency and durability in the machines in use. The coal that is used is of a varied character, including the lignites that have hitherto received but little attention. Gas producers into which a great variety of fuels can be placed and efficiently gasified, are slowly but surely claiming serious attention from the promoters and builders of large plants. The facts as they present themselves at present are these: The cost of the boiler and its pumps and other parts, with the necessity for water of a certain quality, and the highest net resulting efficiency, will not stand a comparison with a gas producer plant under certain conditions, when the same power is produced for electric lighting in one case as the other.

The gas engine is not to be regarded as the full equivalent of the steam engine, however, for the reason that the character of the mixture producing the power, when exploded, leaves its influence eventually upon the walls of the cylinder of the gas engine. The gain in one as compared with the other is that of an explosion and its concurrent results as a power producer over a volume of steam cut off from the main supply, and expanding within certain well defined limits when giving out power. But even though the durability of the gas engine is eventually not as great as that of a steam engine

or turbine, a mooted point at the best, still the fundamental idea is that of saving fuel and the expense that always accompanies its useless or inefficient combustion. In the average central station, a certain grade of fuel determines the net result, as far as its cost and the station output are concerned. A change to a poorer grade of fuel may have the effect of distinctly reducing the capacity of the plant and this in its turn of causing just as distinct a loss financially by curtailing the amount of current that can be sold. A gas producer which can gasify all grades of fuel without any changes being necessary, and which, on account of the wide latitude allowed in their output, has no effect upon the supply of gas required for the engines, is superior because of its immediate practicability and direct application to the needs of central station service. This idea, though of direct interest to the electricity producers of the country, is fully appreciated by mining and metallurgical concerns, as well as many manufacturers of note. Plants of 5,000, 10,000 and 15,000 horse power are becoming commoner than may be thought. Street railway equipments are becoming identified in some sections of the United States with such plants to a surprising extent. By keeping in touch with this transformation of equipment it is possible to understand what it initiates. It cannot be called economy entirely, neither can it be regarded as the result of a desire for a change. The idea lying behind it all, even behind the saving and economy it represents, is the increased simplicity of the plant its use entails. If anything represents the paradox of practice as thus exemplified to-day, it is the complexity and yet the simplicity that pervades modern practice in all its allied branches.

Commutator and Brush Preservation.

The preservation of a generator is largely dependent upon the care and attention given to its commutator. The brushes as well represent a case in which the exercise of common sense means a longer period of usefulness for the machine. Mr. S. Lees, in a paper published in the columns of the *London Electrical Engineer,* develops this theme broadly, and tabulates as much of his data as he thinks of interest to central station men in an interesting manner. He divides brush holders up into swinging arm types and fixed box types; he gives the kilowatts capacity of the machines he took his observations from and notes the actual wearing length of the brushes they use. He also gives the number of pounds pressure with which the brush presses upon the commutator. But the arrangement of all this data in a specific manner is highly illustrative of one of two propositions that no one interested in the smooth operation of generators or motors can well afford to disregard. They are: First, the necessity for a uniform brush pressure with a given grade of brush of a certain known value; and, second, the necessity for choosing a given grade of brush in order to avoid the difficulties which otherwise present themselves at both the brush and commutator. To quote from the author's paper, "The brushes should bear on the surface of the commutator with the least pressure consistent with sparkless commutation. The pressure to use varies greatly with the many different type of brushholders and brushes, and may be anything from a few ounces to as much as six or eight pounds." The variation possible and necessary in the case of brushes, as far as the pressure is concerned, is the basis of the most arbitrary practice in the majority of cases entirely for this reason. A soft brush is evidently not the one to press too tightly to a commutator. It is not the right kind of a brush to use in fact, unless the commutator is made of very soft metal. A hard brush, which is not too brittle, is the right thing. A brush of this type may press upon a tempered copper or bronze commutator with impunity. A case presented by Mr. Lees is that of a 20 k. w. machine running two years with a brush pressure of 1½ lbs., which remained in excellent condition throughout that period. Another case is that of a 100 k. w. machine, with a 5 lb. brush pressure, that operated without any difficulty for 2,000 hours with only five-sixteenths of an inch brush wear. The conclusion inevitably reached is that the relationship between the brush pressure and the brush quality must be determined to avoid rapid deterioration of the commutator and brushes. The author of this interesting paper tested American, English and French brushes of various prices and qualities, with the net conclusion that the highest grade of each always gave the best returns in actual practice. Too much pressure is frequently the cause of grinding wear. Too little pressure is frequently the cause of pitting and sparking. Knowing the character of the commutator metal with respect to the brushes and the converse, is the logical method. Central station and power house practice is successful only on the basis of intelligent operation. A little bit of science on the subject of commutators and brushes may

prove of the highest value to some of our earnest students engaged in central station practice.

Some Features of the Moore System.

Lighting a room by means of a long tube conveniently adjusted with its bends and turns to give a uniform glow throughout the room, has been the latest development in the field of electric lighting. It is curious to realize how we rebel again admitting a system to the bar of public criticism, unless it bears, so to speak, the scars of battle. The vacuum tube system has had a hard and long fight of it, and now it seems it has really seen daylight in meeting certain conditions of practice in a commercial as well as a scientific sense. The light is yellowish, lambent, illuminative and pleasant. One of the objections made to present systems by opticians and ophthalmic specialists is the use of painfully brilliant centers of light. They attribute the enormous number of defective eyes entirely to this fact. The Moore light is one at which the eyes can be directed without any painful consequences. A question arising, therefore in connection with it is this: If it costs no more to run than the incandescent lamp, will its light be regarded as more agreeable; and if it costs more, will this very feature of agreeableness give it a substantial footing among our lighting systems? An aesthetic sense is rapidly developing among all classes in the United States. One of its phases is that of using a well toned light. The experience of ten or more years has been effective in a general way in teaching inventors and the public that quality of light counts for more than cheapness. Along these lines the competition among different forms of electric lighting means either finding a definite place for each or eliminating it.

Electric Light Statistics.

Since 1881 the growth of electric lighting in the United States has been unparalleled in comparison with that of any other electrical industry. The last 25 years have meant the production and use of over a quarter of a billion lamps. More than 4,000 central stations have sprung into active existence at a cost exceeding $500,000,000. They employ more than 24,000 wage earners, and pay out over $15,000,-000. The output of these stations exceed two and one-half billion kilowatt hours annually. The transformation of the original purpose of arc lighting to that of the greater field of incandescent lighting is one of the distinct features of the change. But the development of the industry itself from the eight stations operating in 1881 to 100 in 1886, to 208 in 1889 and 247 in 1892 is indicative of the evolution of not only the station but the generator, lamps and such essential elements of practice as practically constitute the station itself. The newness of the proposition to do electric lighting, however, gave it for a time much of the appearance of an ill advised speculation; and when hard times came, the stations fell away in number in common with other so-called speculative industries. The revival of business in the later years that followed proved a veritable boom in the electric lighting field. As was natural, while conditions were somewhat inchoate, the central station, operated and controlled by private capital, representing one great class of stations, found arrayed against it the municipal plants operated and controlled by the city or town government. The public rapidly concluded that electricity for lighting and power was part of the fixed program of civilization, and in consequence instead of senseless objections being made to its use, and stumbling blocks being placed in the path of initiators of such schemes, actual demands were made for electric lighting. No towns or cities of even the most moderate pretensions are unlit by electric lights. Paralleling this movement came the development and spread of electric roads. It is as much a psychological as an economic conclusion that leads a great mass of people to make a simultaneous demand for a thing they once feared, admired, thought too expensive and finally enthusiastically adopted. Yet this is in many respects the true picture of the early days of electric lighting. With defective dynamos, poor lamps, badly insulated wire and an undeveloped system of lighting, the wonder is that order came out of such chaos in so short a time. This order has manifested itself in the separation at first of the alternating and direct current systems of light and power. Dictated by science, economy and engineering practice, the two forms of lighting combined into what is now termed a central station. No line is drawn there as to the character of the current employed. The questions involved are those of getting customers to use the output, caring properly for the machinery, and aiming at an efficiency of operation that will at least leave no blame upon the electrical side of the enterprise. The sale of current is now the objective point, since the operation of the station has been properly defined.

THE TWENTY-NINTH CONVENTION

Fourteen hundred and sixty-one delegates were officially registered at the 29th convention of the National Electric Light Association, held on Young's Pier, in Atlantic City, June 5th to 8th. This number is the record in attendance since the association was formed in 1885, and exceeds in number that of the next largest convention, which was the 27th, and which was held in Boston in May, 1904, 1,189 delegates establishing the record until this year. On Monday, June 4, every special and regular train bound to Atlantic City from the North, West and South, bore hundreds of delegates who wished to be on hand at the opening of the electrical exhibition of the associate members, which took place at nine o'clock that evening on Young's Pier.

ARTHUR WILLIAMS,
President.

DUDLEY FARRAND,
First Vice-President.

W. C. L. EGLIN,
Secretary and Treasurer.

OFFICERS OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION, 1906-7.

The convention was formally opened on Tuesday morning, June 5, shortly after ten o'clock, with an address of welcome by his honor, Mayor S. P. Stoy, of Atlantic City, followed by the address of the president of the Association, Mr. W. H. Blood, Jr.

PRESIDENT'S ADDRESS.

"Last year we enjoyed the hospitality of the West, and the trip to Denver and Colorado Springs in special through trains was a feature of the gathering. This year you have come to the extreme East, where you may admire the Atlantic ocean with its tempestuous waves and contrast its vastness with the royal splendor of the mountains you saw last year.

"The Association is to be congratulated upon its continued growth and prosperity. Two years ago,

when we met in Boston, the total membership was 588. To-day we have nearly double this number, for we have enrolled 1,024. The vigorous campaign for new members, inaugurated two years ago, has been continued in a less expensive manner, but with most satisfactory results, by our efficient assistant secretary and treasurer.

"The question of annual dues should receive the prompt consideration of the incoming administration. It may be expedient to increase the fees of the companies operating in the largest cities. It is desirable, your president believes, to so adjust the dues in cities of ten thousand population, or under, that companies operating therein cannot afford to stay out of the organization. We need the coöperation of just such members, and the affiliation with the stronger companies, through the Association, will enable them to get information or assistance which, if operating alone, might be expensive, if not impossible to obtain.

"The Class 'C' members—college professors—have received the careful consideration of your president during the past year, and as a result of his investigations he unhesitatingly recommends that they be treated as an honorary class, that no fees be exacted, and that they be admitted upon invitation only, and that each case be passed upon annually by the executive committee. We desire the fellowship of many earnest educators for their own sake and because of the influence which they have over the hundreds of young men they are sending out each year from the technical schools. On the other hand, this association has no place for the instructor, with only academic ideas as to corporate management, who in his capacity as consulting engineer either ignorantly or wilfully misrepresents the facts.

"Our relations with the underwriters have, during the past year, been pleasant, partly because there has been no question at issue between us and also because we are becoming better acquainted with each other. The policy of having a representative of the Association devote the larger portion of his time to insurance interests and to settling differences between the members of the Association and the underwriters has been approved by the executive committee, and is now referred to the incoming board for early action.

"The year has shown a healthy growth of the electric lighting business, but it is not notable as having given birth to any marked innovation in the physical part of the business. The size of generating units continues to increase, distribution by high-tension alternating current is becoming more and more general, and minor improvements all along the line are extending the utility of this system. Undeveloped water powers, which a few years ago were valueless, are to-day being eagerly sought out, and by means of improved water-wheels and high-tension lines are being made available for large sections of the country. Gas engines, steam turbines and other prime movers are receiving the careful attention of enterprising engineers, because we are all beginning to realize, more and more forcibly each year, that the great losses between the coal pile and the dynamo must be cut down.

"There has been a marked increase in centralizing the ownership of electrical undertakings. This has benefited the communities served, by bringing to their service better management as well as improved operating methods. This centralization is causing electrical managers to look more closely to their markets, and to-day the company that has not a new business-getting department is sadly behind the times.

"Allied with the question of rates is the problem of government supervision or regulation. This matter is demanding serious consideration at the present time. Witness the Massachusettts Gas and Electric Light Commission, which has been in existence several years, the newly formed New York State Lighting Commission and the bill just passed by the Massachusetts Legislature adopting the English automatic method of control called 'The Sliding Scale System.'

"A study of the municipal undertakings in Great Britain and the constantly growing list of municipal failures in the United States shows that municipal ownership is, in fact, no longer as popular as it once was. Some agitation, however, is being kept alive by the socialist, by the unscrupulous political agitator and by the 'yellow journal,' whose whole fabric is based upon class hatred, whose teachings are that all riches come through stealing from the poor and whose very existence depends upon its ability to pervert the facts and to 'fake' reports so as to make interesting reading for the part of the public loving sensation.

"A general reduction in price for current and a readjustment of rates are constantly taking place all over the country. Flat rates are fast becoming things of the past, and wattmeters, in conjunction

with various kinds of demand systems, are now almost universally used. Although the public has been for years trying to understand the demand system of charging, it still objects to it, and there is a feeling in some quarters that we may have to return to the straight meter rate, which, although admittedly unjust and unfair, still has a decided advantage in its simplicity."

Following the president's address, was the report of the Committee on Progress, read by Mr. T. Commerford Martin. Mr. Martin's report shows that the central station manager has, within the last two years, received more advice as to the sale of his current than he endured as to its manufacture in the whole previous twenty years.

It may be asserted without the slightest fear of contradiction that the industry has been revivified by the publicity campaign of recent date, that it has ceased to minister to the comfort of the many in order to meet the necessities of the million, and that it has made splendid advances toward the accomplishment of its universal purpose and potentialities. It was estimated in this report that there are to-day 4,839 electric lighting and power stations, of which 3,732 were under private or corporate management, and 1,107 were municipal. The gain in six months has been 301 plants, or 600 for the year, representing a capital invested of over $700,000,000.

The gross earnings of these central stations are estimated at $135,000,000, expenses on which at 70 per cent. would amount to $94,500,000. As a matter of fact, the output of current was everywhere much larger than ever before, but the rates obtained were, in many cases, much lower.

The report estimates the total output of all strictly electrical apparatus, made up from the United States Census Bureau Report of 1904, to be $157,949,514.

Following Mr. Martin's excellent and interesting report, Mr. W. S. Barstow, of Portland, Oregon, read his paper on "Mercury Arc Lamps and Mercury Rectifiers." Mr. Barstow's paper will be reproduced in full in a subsequent issue of THE CENTRAL STATION. The last paper of Tuesday morning's session was entitled "The Flaming Carbon Arc Lamp," read by Mr. Louis B. Marks, of New York City, the inventor of the enclosed arc lamp, and president of the Illuminating Engineering Society, of New York City. This paper, which was most interesting and important, and which discussed at length the characteristic differences between the flaming carbon arc and the ordinary open and enclosed arc, will be reproduced in full in a subsequent issue of THE CENTRAL STATION.

Shortly after two o'clock of the same day, President William H. Blood, Jr., called the second session to order, which commenced with the report of the Steam Turbine Committee, of which Mr. W. C. L. Eglin, secretary of the Association, was Chairman. Following Mr. Eglin's report, Mr. John Meyer read his paper entitled "Mechanical Refrigeration." Mr. Meyer showed very clearly that mechanical refrigeration, having as its source of power the electric motor, is an important outlet for central station current, and deserves much consideration. The paper deals with the subject from a central station manager's standpoint.

The next paper presented was by Mr. J. H. Hallberg, of New York, entitled "Fuel Economy." Following Mr. Hallberg's interesting paper, Mr. James I. Ayer, President of the Simplex Electric Heating Company, a veteran of the National Electric Light Association, and one of the best known living authorities on electric lighting, presented his paper on this latter subject. The substance of Mr. Ayer's paper was the importance of directing attention to the great possibilities of electrical heating and cooking devices among residence customers of central stations. Mr. Ayer showed a table of costs for hot-water heating, which substantiated the force of his proposition. The policy for central station men to pursue, says Mr. Ayer, is to press the sales of electrical heating and cooking apparatus until their own popularity will cause them to become a standard of household economy. The next paper was entitled "Line Construction for Overhead Light and Power Service." This paper was prepared by Mr. Paul Spencer and Mr. W. D. Partridge, and was read by the latter. Safety of the public and the company's employees, together with the reliability of the company's service, are the fundamental points to be considered in line construction, and were dwelt upon at length in this interestig paper which will be reproduced in full in a subsequent issue of THE CENTRAL STATION. At the conclusion of the above paper, the meeting adjourned for the day.

After the Wednesday morning session had been called to order, Mr. John C. Hammond, of New York, read a paper entitled "Business Getting Methods," which was prepared by Mr. Frank W. Frueauff, Mr. Frueauff himself being unable to be present. Following this paper, Mr. D. F. McGee read a most valuable paper entitled "How to Make a

Small Electric Plant Pay." Mr. McGee urges the managers of small plants to keep posted regarding the latest and most efficient types of different apparatus, lamps, reflectors, etc., and should read the trade publications devoted to his interests, not only the reading matter, but should study the advertisements as well. He will miss a great deal of valuable information if he does not. He will often find the solution in those pages of difficult problems that may have bothered him for months. The next paper presented was entitled "Some Methods Used in Securing and Retaining Business," presented by Mr. M. E. Turner, Mr. R. S. Wallace, Mr. George B. Tripp, Mr. L. H. Schereck and Mr. Norman I. Wilcox. The suggestion presented by the above-named gentlemen are too important to be abstracted in this issue, and will be printed in full in a later number.

The last paper of the second morning's session was entitled "Free Installation of Electric Signs," by Mr. John F. Gilchrist, of Chicago.

The Wednesday afternoon session, June 6, was opened by the reading of a paper on a subject which is creating the greatest interest in the central station, as well as the manufacturing, field, entitled "Profitable Commercial Co-operation," by Mr. J. Robert Crouse. Mr. Crouse's paper outlined, in a clear and comprehensive manner, his plan for cooperation among all branches of electrical industry and development. Mr. Crouse has, for the past year, given almost his entire time, and has worked like a Trojan on this co-operative plan which is meeting with universal approval. Mr. John F. Gilchrist then read the report of the committee to cooperate with Manufacturers' Advertising Committee. It was moved and carried that a committee of the National Electric Light Association continue the work of co-operation with the manufacturers, and their report, which will be presented at the next meeting of the Association, will be looked forward to with the greatest interest.

In the absence of Mr. Alex. Dow, of Detroit, Mich., Chairman of the Committee of Protection from Lighting during 1905, this report was read by Mr. Robert S. Stewart, one of the committee on this subject. A circular letter was sent by this committee to all the members of the National Electric Light Association, asking for information in regard to lighting troubles during 1905. In all, only one hundred and thirteen companies reported, and of this number only one-third reported any particular damage from lighting during the past year.

The report shows that the money value of property destroyed or injured by lightning was extremely small compared with the value of the plants, for, even when transformers were burned out, they were repaired at but slight expense, the principle loss being due to interruption of service. The freedom of trouble from this source is due largely to the increased use of lightning arresters, and to the high grade in the material and care used in the insulation of modern transformers and generators. The paper on "Grounding Secondary Alternating Current Service" and read by Mr. C. H. Herrick, in the absence of Mr. Sidney Hosmer, the author. The last report of Wednesday's session was that of the Committee on the Fire Hazard of Electricity, and was presented by the Chairman of the committee, Mr. H. C. Wirt. In this report it was not the object to minimize the fire hazard of electricity, but to show, by actual comparison, the relation of this hazard to that of other agencies supplying the same general class of service. The excellent showing is, no doubt, due to the careful supervision and inspection by the insurance interests and the municipal authorities. Mr. W. H. Merrill, Jr., Secretary of the Chicago Board of Fire Underwriters, said that it was very important that the Association recognize the importance of the fire hazard. Mr. Merrill suggested the appointing of an expert by the Association, to look into the matter and present accurate data to the Association.

The opening session of Thursday morning, June 7, was called to order shortly after ten o'clock by President Blood, and the first paper presented was by Mr. C. W. Stone, on "Alternating Current Systems of Distribution and Their Automatic Regulations." Following this paper, Mr. William Bradshaw read his paper on "The Maintenance and Calibration of Service Meters." Both of the above important papers will be published in full in a later issue of this paper. The next paper persented was on alternating current elevators, read by its author, Mr. W. N. Dickinson, Jr. The next paper presented at this session was on the "Control of Motors on Electric Light and Power Circuits," by Mr. H. D. James, at the conclusion of which the meeting was adjourned until 8.30 in the evening.

At the Thursday evening session, Mr. E. W. Burdett presented an address on the meaning and proper treatment of the agitation over municipal ownership of public utilities. At the conclusion of Mr. Burdett's interesting address, Mr. Percy Ingalls moved

a rising vote of thanks to Mr. Burdett, which was unanimously carried.

The first paper read at the Friday morning session, June 8, was on "New Illuminants," by Professor H. E. Clifford. Following Prof. Clifford's interesting paper, a most important one was read by Mr. Francis W. Wilcox entitled "The Higher Efficiency Incandescent Lamps, Their Value and Effect on the Central Station Service." This paper dealt with the new metalized filament lamp now being put on the market by the General Electric Company.

"The Edison System of Southern California," was the subject of the next paper, which was presented by Mr. R. H. Ballard. The last paper of the general sessions was an abstract by Mr. C. A. Tupper, of Mr. E. F. Cassell's paper on "The Design and Manufacture of Hydro-Electric Installations."

At the executive session, which took place after the open session of Wednesday afternoon, a committee to name officers was appointed and consisted of Mr. James I. Ayer, of Boston; Mr. Samuel Scocil, of Cleveland; Mr. J. E. Montague, of Niagara Falls; Mr. J. T. Cowling and Mr. Percy Ingalls, of Newark, N. J.

An amendment to the Constitution was proposed to provide for an invited membership class, to be composed of college professors. The amendment was referred to a committee consisting of Mr. Arthur Williams, Mr. Dudley Farrand, and Mr. W. C. L. Eglin.

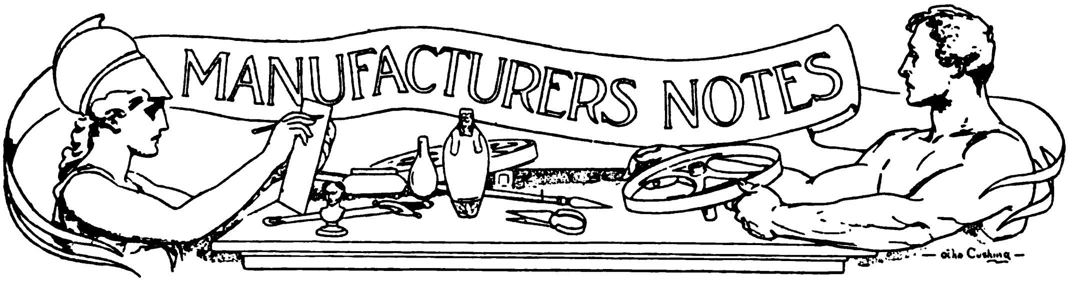
A committee to revise the Constitution and By-Laws, consisting of Mr. Louis A. Ferguson, of Chicago; Mr. Samuel Scovil, of Cleveland; Mr. W. C. L. Eglin, of Philadelphia, was appointed.

Following is the list of officers elected to serve until the next convention:

President, Mr. Arthur Williams, of New York City; First Vice-President, Mr. Dudley Farrand, of Newark, N. J.; Second Vice-President, Mr. Alex. Dow, of Detroit, Mich.; Secretary and Treasurer, Mr. W. C. L. Eglin, of Philadelphia, Pa.

The following gentlemen were elected to serve for three years on the Executive Committee:

Mr. Charles R. Huntley, of Buffalo, N. Y.; Mr. L. A. Ferguson, of Chicago, Ill., and Mr. F. M. Tait, of Dayton, O.



At the Convention.

The election of Mr. Arthur Williams to the presidency of the National Electric Light Association, Mr. Dudley Farrand as Vice-President, and Mr. W. C. L. Eglin, who was re-elected Secretary and Treasurer, all of whose photographs are shown in this issue, met with unanimous approval and gratification, and the hearty congratulations which were extended to these newly elected officers must certainly assure them of the coöperation which they will undoubtedly receive and deserve from every member of the Association. Mr. George F. Porter proved himself, as usual, a most efficient and valuable Master of Transportation, and it is to be hoped that he will be at the head of the "Get-there-and-back" details for the next convention. These four men, together with the untiring work of Miss Harriett Billings, as Assistant Secretary, cannot but assure the record-breaking convention of 1907 which in all probability will be held at Saratoga, N. Y.

The Electrical Exhibition held on Young's Pier by the associate members of the Association, was fully as important a factor in the success of this convention as the excellent papers and discussions presented at the regular sessions. The interest displayed in the up-to-date apparatus, circulars and other literature, shown at the various booths, by the hundreds of central station managers and superin-

tendents from all over the United States and Canada, who are buyers of apparatus and not souvenir hunters and purchasers of molasses candy, which made up 99 per cent. of the visitors at the so-called electrical exhibition given last winter in Madison Square Garden, will not only make this one of the most important features of all coming conventions, but will certainly sound the death knell of all so-called "Electrical Expositions" run by a few individuals whose one object seems to be the selling of floor space, irrespective of the character of the exhibitions or the exhibitors. It is safe to say that the trouble and expense borne by the exhibitors at this convention will be paid back, directly and indirectly, a hundred-fold. The credit for this most satisfactory and profitable exhibit is certainly due to the untiring efforts and executive ability of our newly elected president, Mr. Arthur Williams, who was chairman of the Exhibition Committee.

The Westinghouse Electric & Manufacturing Company, of Pittsburg, were the most largely represented; they having retained twenty-five rooms in one of the largest hotels in Atlantic City, for the accommodation of their representatives, a large number of whom were constantly in attendance at their booth at all times. Mr. L. A. Osborne, Second Vice-President, and Mr. W. M. MacFarlan, acting Vice-President, were the commanding officers in charge of the Westinghouse attack and defense. Among the other Westinghouse representatives were: Mr. C. S. Cook, Manager of Railway and Lighting Sales Departments; Mr. S. L. Nicholson, Mr. C. B. Humphrey, Mr. M. Coster, Mr. W. C. Webster (Mr. Osborne's assistant), Mr. W. F. Fowler, Mr. Paul T. Brady, Mr. C. S. Powell, Mr. H. C. Stier, Mr. D. E. Drake, Mr. F. W. Andrew, Mr. C. Aalborg, Mr. H. H. VanStaagen, Mr. G. E. Miller and Mr. J. C. McQuiston, Superintendent of the Westinghouse Companies' Publishing Department. Sawyer-Man Electric Company was represented by Mr. Walter Carey, Manager; Mr. H. V. Jackson and Mr. Guy V. Williams. Westinghouse Machine Company was represented by Mr. E. B. Sniffen, Third Vice-President, and from the Nernst Lamp Company came Mr. Max Harris, General Manager of Sales, and Mr. C. W. Davis. The spectacular feature of the Westinghouse exhibit was a large model of their Type C, single-phase wattmeter. It was an enlarged model of this instrument, and stood ten feet in height and five feet deep. This instrument, with its revolving disk, could be seen from every part of the Exhibition Hall. In this exhibit was also shown the new Type K mercury vapor lamps, Nernst lamps, and a complete line of Westinghouse arc lamps which, during the evening hours, were used to illuminate the booth. The new Nernst series-alternating vertical-glower system of street lighting created a great deal of attention. The entire exhibit was in charge of Mr. J. C. McQuiston, Superintendent of the Westinghouse Companies' Publishing Department.

General Electric Company, of Schenectady, as is their usual custom at such exhibitions, showed a few of their latest and most interesting developments, and although their entire exhibit, as far as apparatus was concerned, could have been placed in a good-sized suit case, it created a great deal of interest, and consisted principally of their new line of high efficiency incandescent lamps, Tantalum lamps, fans and magnetite luminous arc lamps. The Tantaium lamp, concerning which we have all heard and read so much during the past year in the technical press, was formally introduced to central station interests and excited a great deal of interest and speculation as to its probable future. Among those constantly in attendance and constantly answering questions regarding these new sensations were: Mr. F. H. Gale, Manager of the Advertising Department; Mr. G. L. Thompson and Mr. H. J. Buddy, of the Philadelphia office; Mr. P. D. Wagoner, Mr. G. W. Stone and Mr. J. H. Gilbert, of Schenectady; Mr. A. D. Page and Mr. F. W. Wilcox, of the Harrison Lamp Works; Mr. Charley Burleigh, Mr. A. F. Giles and Mr. H. W. Brown, of the Boston office; Mr. L. H. Lewis and Mr. Babson, of the New York office, and Mr. J. Scribner, of the Chicago office.

The General Storage Battery Company, of New York, made a very comprehensive exhibit of the Bijur high duty type of storage battery and charging booster, consisting of a constant speed motor driving a separately excited generator. The Bijur cells used in electric lighting and railway plants were shown, as well as their small cells which are now becoming so popular in yacht lighting. A complete line of their plates, showing every detail of their construction, was also exhibited, the company being represented by Mr. R. C. Shaal and Mr. F. E. Booss.

The Stanley-G. I. Electric Manufacturing Company, of Pittsfield, Mass., exhibited their Wright Demand indicators, which, together with their switches, circuit breakers and other complete lines

of G. I. enclosed arc lamps, created a great deal of interest. This company also exhibited one of its latest types of direct current motor generator sets, S. K. C. induction, motors, transformers, lightning arresters, and a complete line of their lighting and wiring specialties. The company was represented by Mr. H. C. Rice, Manager of the Arc Lamp and Transformer Departments; Mr. M. D. Barr, Mr. J. H. Noble, Mr. A. W. Henshaw, Mr. J. E. Cutler, Mr. A. H. Abell, Mr. Almon Foster, Mr. J. S. Codman and Mr. E. B. Dodd.

Allis-Chalmers Company, of Milwaukee, had a very large and interesting exhibit in which they showed and explained their new type of induction motor generator set, together with a line of induction and direct current motors. A very interesting model of the stationary and moving blades of the new Allis-Chalmers steam turbine was also shown. This exhibit was in charge of, and arranged by, Mr. C. S. Tupper, of the Publicity Department. Among those who assisted in exhibiting these specialties which, naturally, were but a very small proportion of the enormous variety of apparatus constantly being turned out by this company, were Mr. L. E. Bogen, Mr. G. W. Pulver, Mr. F. L. Bunton, Mr. P. S. Gibson, Mr. W. H. Powell, Mr. J. C. Lucas, Mr. M. W. Thomas, and Mr. W. S. Doran.

American Circular Loom Company, of Chelsea, Mass., was represented by Mr. Harry B. Kirkland, general sales manager of the company, assisted by Mr. R. B. Corey, Mr. Alex. Henderson and Mr. H. C. Adams, of the New York office. Aside from their exhibit of American Circular Loom, and Electroduct, which is too well known and too universally used to require any description, their new "Lutz" metal moulding was exhibited and brought forth universal expressions of approval. This moulding is not only the latest development, but unquestionably the best and safest moulding that could possibly be used for the canalization of electric circuits exposed on walls, ceilings and floors. This new type of metal moulding commends itself most forcibly to all good and permanent construction and should, without any question of doubt, be universally adopted and required in preference to all the old-fashioned wooden moulding which never has been anything but an excuse, and unquestionably the source of a great many fire losses which have gone down into history under the heading of "Unknown causes of fire." This new "Lutz" metal moulding, which is now being placed upon the market by the American Circular Loom Company, is complete in every detail, as standard and irregular angles, knees and connections are furnished to meet every conceivable requirement. It is not only free from any possibility of mechanical injury, it being impossible to be injured by nails or screws, but it also occupies about one-half the space required by the obsolete type of wooden moulding heretofore used for the same sizes of wires.

National Carbon Company, of Cleveland, O., was represented by Mr. N. C. Cotabish, General Sales Manager; Mr. D. D. Dickey, General Manager; Mr. K. E. Hackenberg, Treasurer; Mr. J. S. Crider, Secretary; Mr. A. N. Barron, Manager of the Works; Mr. J. F. Kerlin, Assistant Manager of Sales, together with the following salesmen: Mr. W. C. Banks, Mr. A. D. Spear, Mr. E. J. Kenny, Mr. C. W. Wilkins, Mr. F. H. McDowell, Mr. A. E. Carrier, Mr. A. C. Henry and Mr. J. C. Irvine.

The H. W. Johns-Manville Company, of New York, had a most interesting exhibit of their entire line of Noark National Electric Code standard enclosed fuses and fittings. Aside from this complete line of fuses, a most interesting line of high potential porcelain insulators, designed for voltages up to eighty thousand, which naturally created a great deal of interest and inquiry from central station managers and superintendents from all over the country, was also exhibited. The company was represented by the manager of the electrical department, Mr. J. W. Perry; Mr. C. N. Manfred, Manager of the Advertising Department, and representatives from their Philadelphia, Boston and New York offices. One of the most attractive souvenirs of the convention was given away by this company, consisting of a metal ash tray surmounted by a match box in the shape of a Noark fuse plug.

Wagner Electric Manufacturing Company, of St. Louis, Mo., was represented by their general manager, Mr. W. A. Layman.

The Standard Underground Cable Company, of Pittsburg, was represented by Mr. C. J. Marsh, Mr. G. L. Wiley, Mr. H. P. Kimball, and Mr. R. S. Hopkins, of the New York office. Mr. H. W. Smith, and Mr. C. W. Davis, of the Pittsburg office, were also present.

The Duncan Electric Manufacturing Company, of Lafayette, Ind., had a most interesting exhibition of its latest types of direct current wattmeters. Their new type of wattmeter has become very popular in central station practice, the result being that

the factory is crowded to its utmost to keep up with its orders. This company was represented by its president, Mr. Thomas Duncan, and its general sales manager, Mr. William H. Sinks.

The Standard Vitrified Conduit Company, of New York, exhibited a line of its vitrified underground conduit in all its forms, including the single and multiple ducts, and was represented by the president of the company, Capt. B. S. Barnard. Capt. Barnard is also president of B. S. Barnard & Company, New York, whose manager, Mr. G. A. Nesbit, of the Electrical Department, assisted the Captain in the interests of the lattter company.

The Fiber Conduit Company, of Orangeburg, N. Y., showed a very interesting line of their fiber conduits, elbows, joints and fittings which are now being extensively used in underground and central station construction. The above company was represented by its vice-president, Mr. W. W. Grant, assisted by his New England manager, Mr. S. G. Thompson, and Mr. W. W. Smythe, Jr., manager of the western office.

The Holophane Glass Company, of New York, manufacturers of the scientifically designed and constructed "Holophane" glass globes, reflectors and diffusers, was represented at the convention by Mr. V. R. Lansingh, General Manager of the Sales Department, and Secretary of the Illuminating Engineering Society. The product of this company, like the Mellin's Food baby, is advertised by its loving friends, there being substantial evidences of the value of "Holophane" globes and reflectors in many of the booths on Young's Pier. In the booth of the General Electric Company, for instance, all of the high efficiency Meridian and Tantalum lamps were crowned by "Holophane" Pagoda Reflectors. The Federal Electric Company's exhibit used the "Holophane" reflectors throughout. Probably the most striking exhibit of the Holophane product was a twenty-two inch spherical "Holophane" globe, mounted on a fifteen-foot pillar in the center of the booth occupied by THE CENTRAL STATION. In the interior of this large "Holophane" globe was a five-light Benjamin wireless cluster, equipped with as many "Skedoodle" socket plugs, in which were five different colored Sawyer-Man lamps, which flashed the various combinations of colors, producing a beautiful effect, and one which created a great deal of favorable comment and inquiry.

Mr. G. M. Gest, expert conduit and electrical subway contractor of New York and Cincinnati, was represented by Mr. R. E. Brandeis, his exhibit consisting of a very interesting series of photographs and drawings of the conduit construction work which Mr. Gest is doing all over this country, which was combined with the exhibit of the American Vitrified Conduit Company, and that of the H. B. Camp Company. Mr. Stephen A. Douglas, with his assistant, Mr. C. C. Baird, was in attendance during the entire convention, and devoted himself to saying the right thing to the right people at the right time. The orders that Mr. Douglas brought back from the convention for conduit would have choked a twelve-inch water main.

Pass & Seymour, Inc., of Solvay, N. Y., was represented at this convention by Manager of Sales, Mr. J. W. Brooks.

The Gould Storage Battery Company, of New York, exhibited a complete line of its batteries for central station vehicle and marine work. The exhibit was constantly looked after by Mr. Hulme, Mr. Littlefield and Mr. Powers, of the New York office.

The Excello Arc Lamp Company, of New York, exhibited its new "Sunray" arc lamp for outdoor use, and also its "Excello" snowball lamp for indoor use. The exhibit was in charge of Mr. O. Baerwinkel, secretary of the company, assisted by Mr. H. E. Dinsmore. The president of the company, Mr. H. M. Hirschberg, was not present, having sailed for Europe on business connected with his lamp factories and carbon works. Mr. Hirschberg will spend several weeks in Europe, arranging for the prompt delivery of "Excello" lamps and carbons, in order to fill the large number of orders for these lamps which are pouring in.

The Power & Mining Machinery Company, of New York, was represented at the convention by Robert T. Lozier.

The National Metal Molding Company, successors to the Osborn Flexible Conduit Company, had a very interesting and practical exhibit in charge of Mr. C. E. Corrigan, General Manager of the company, who was assisted by Mr. J. A. Campbell. The exhibit consisted of a complete line of "Economy" conduit and "Flexduct."

The Sarco Company, of New York, was represented by President R. H. Schoenberg, who exhibited the "Sarco" pendant switch, the merits of which Mr. Schoenberg himself explained at the booth of THE CENTRAL STATION.

The Sangamo Electric Company, of Springfield, Ill., was represented by Mr. R. C. Lanphier, secre-

tary of the company, assisted by Mr. T. F. McKenna. They showed their new types of alternating and direct current wattmeters.

Mr. John L. Gleason, of Jamaica Plain, Mass., had a most interesting exhibit of his patented molding and conduit, junction, switch and outlet boxes. Mr. Gleason was assisted at his exhibit by Mr. Reinhold Eberhardt.

The Phoenix Glass Company, of New York and Pittsburg, manufacturers of the famous inner and outer arc lamp globes of that name, was represented by Mr. A. H. Patterson, of New York, vice-president of the company, and by Mr. E. P. Ebberts, of Pittsburg, treasurer of the company. This company is doing an enormous business, not only with its inner and outer arc lamp globes, but also with its plain and decorated incandescent lamp globes and shades, which form one of the most extensive and varied lines made by any manufacturer in the world.

Chase-Shawmut Company, of Newburyport, Mass., manufacturers of "Shawmut" National Electrical Code standard enclosed fuses, now so extensively used in central station service, was represented by Mr. Harry P. Moore, Manager of Sales, and Mr. L. J. Coster, Manager of the Philadelphia office.

The Beck Flaming Arc Lamp Company, was represented by its president, Mr. Louis J. Auerbacher, of New York, who showed and explained the workings of the Beck flaming arc lamps, which created a great deal of attention.

D. & W. Fuse Company, of Providence, R. I., manufacturers of the well-known D. & W. National Electrical Code standard enclosed fuses, was represented by Mr. W. S. Sisson.

The Economical Electric Lamp Company, of New York, manufacturers of the "Economical" turn-down lamps, was represented at the convention by Mr. L. Lobenthal, general manager of the company, who exhibited this well-known lamp, and also showed the central station managers present his "Silent Salesman," a mechanical device for demonstrating to prospective central station customers the convenience and ease of operation of the "Economical" Turn-Down Lamp. Central station managers all over the country are carrying "Economical" lamps in stock for the convenience of their customers.

The Oneida Community, Ltd., of Oneida, N. Y., exhibited their galvanized chains for arc lamp suspension. These chains are also used for the suspension of electric signs, the exhibit being in charge of Mr. S. A. Leonard, Manager of the Hardware Department, and Mr. V. W. Lee.

The Simplex Electric Heating Company, of Cambridgeport, Mass., the largest manufacturers of electric heating and cooking apparatus in the world, had a most interesting and practical exhibit consisting of their complete line of electric heating and cooking utensils. The exhibit was in charge of Mr. James I. Ayer, general manager of the company, whose paper on this subject, read before the convention, created a great deal of interest. Mr. Ayer was assisted by Mr. C. W. Richards, Mr. Charles H. Johnson, and the manager of the New York office, Mr. Roger Williams.

American Electrical Works, of Providence, R. I., one of the largest and oldest manufacturers of bare and insulated wires in this country, was represented by Mr. Donohue, manager of the New York office.

The Warren Electric & Specialty Company, of Warren, O., was represented at the convention by Col. E. E. Nash.

Buckeye Electric Company, of Cleveland, O., manufacturers of the Buckeye lamp, was represented by its manager, Mr. L. P. Sawyer.

The Bryan-Marsh Company, was represented by its New York manager, Mr. George G. Lockwood, and by its Chicago manager, Mr. Ernest H. Haughton. Mr. Haughton was accompanied by his wife, in the presence of whom even the brilliancy of the Tantalum lamp retired to insignificant specks in the background.

The Benjamin Electric Manufacturing Company, of Chicago, Ill., manufacturers of the famous wireless clusters, was represented by New York manager, Mr. B. G. Kodjhanoff.

Kuhlman Electric Company, of Elkhart, Ind., was represented by Mr. Kuhlman.

The Okonite Company, of New York, was represented by Capt. Willard L. Candee.

Shelby Electric Company, of Shelby, O., manufacturers of the well-known useful light lamp of that name, had a very interesting exhibit in charge of President J. C. Fish.

The Triumph Electric Company, of Cincinnati, was represented by its general manager, Mr. W. H. Jacobs.

The Crocker Wheeler Company, of Ampere, N. J., showed a complete line, in the smaller sizes of their direct current motors and samples of their new transformers, a complete description of which was given in the May issue of THE CENTRAL STA-

TION. The exhibit was in charge of Mr. DeGress, manager of the New York office, assisted by Mr. W. C. Appleton, of the factory, and Mr. R. N. C. Barnes, of the Boston office.

The Weston Electrical Instrument Company, of Newark, N. J., the largest exclusively electrical instrument manufacturers in the world, was represented by its president, Dr. Edward Weston.

The Standard Paint Company, of New York City, manufacturers of the well-known P. & B. insulating compounds, was represented by its advertising manager, Mr. P. M. Wade, and Mr. J. N. Richards, general manager of sales.

The Banner Electric Company, of Youngstown, O., manufacturers of the Banner lamp, was represented by Mr. N. L. Norris, its manager.

American Electric Lamp Company, of New York, which has just completed one of the most modern lamp factories, was represented by its general manager, Mr. C. J. Purdy. A large painting of this new Philadelphia factory was on exhibition in the booth of THE CENTRAL STATION, and many of the delegates, during and after the convention visited it.

Tipless Lamp Company, of New York, exhibited its complete line of standard and miniature lamps, and was represented by its president, Mr. H. J. Jaeger, who was assisted by his manager of sales, Mr. R. S. Carrick.

The Southern Exchange Company, of New York, one of the largest manufacturers of poles and cross arms, had a very interesting exhibit adjoining that of THE CENTRAL STATION, and was in charge of Mr. E. B. Chamberlain, president of the company, assisted by Mr. W. G. Mitchell, general sales manager. Samples of the long-leaf, yellow pine, of which their famous poles and cross arms are made, were exhibited. This company gave away most attractive souvenirs in the shape of match boxes.

The Dearborn Drug & Chemical Works, of Chicago, Ill., removers and preventers of boiler scales, were represented by General Manager Robert F. Carr, W. B. McVicker, Second Vice-President, Mr. George R. Carr, and Mr. H. G. McConnaughy.

The Phelps Co., of Detroit, Mich., manufacturers of the "Hylo" lamps and specialties, had a very striking display of their lamps and their operation. It was a bunch of "Skedoodle" plugs, a product of this company, which produced the beautiful color effects in the twenty-inch Holophane globes surmounting the pillar in the exhibit of THE CENTRAL STATION.

The Fort Wayne Electric Works, of Fort Wayne, Ind., showed their complete line of type K and type W wattmeters, prepayment wattmeters, type A transformers and their form C arc lamps.

The Electric Storage Battery Company, of Philadelphia, had by far the most massive, as well as one of the most interesting exhibits on the pier, consisting of a very complete line of "Chloride Accumulators," in connection with which was shown, in actual operation, its end-call motor controlled switch. Mr. Charles Blizzard, vice-president and manager of sales, spent a great deal of his time at this exhibit answering questions and receiving a large number of central station managers who were very must interested in the subject. Mr. Blizzard was assisted by Mr. E. L. Reynolds, Mr. Frank J. Stone and Mr. Albert Taylor, representing respectively the Pennsylvania, New York and Boston territories.

The Niagara Tachometer and Instrument Company, of Niagara Falls, N. Y., showed a complete line of their instruments in charge of Mr. C. H. Vaughen, general manager of the company, assisted by Mr. J. A. Phillips, Engineer and Superintendent.

The American Instrument Company, of Newark, N. J., exhibited their new line of American round pattern switchboard and portable instruments, the exhibit being in charge of Mr. James G. Biddle, Mr. A. O. Benicke and Mr. I. G. Seixas.

The American Electrical Heater Company, of Detroit, Mich., the great western manufacturers of electrical heating and cooking apparatus, was represented by President P. H. Scranton, and Secretary Robert Kuhn.

John A. Roebling's Sons' Company, of Trenton, N. J., was represented by Mr. H. L. Shippy, Mr. Albert Mann and Mr. G. W. Swan.

The Munder Electric Company, of Springfield, Mass., manufacturers of the "Munder" lamp, was represented by its president, Mr. Charles F. Munder. Atlantic City is one of the Munder Company's largest customers, this company furnishing enormous quantities of lamps for signs and other purposes. The large electric sign extending almost the full length on the outside of the exhibition portion of Young's Pier, was equipped entirely with Munder lamps and made a very impressive display.

Philadelphia Electric & Manufacturing Company was represented by Mr. C. L. Bundy, General Manager, assisted by Mr. R. H. Manwaring, and exhibited their line of subway fuse boxes, incandescent street lighting fixtures, and other central station specialties.

At no convention of the National Electric Light Association has there been the display of interest in the subject of New Business Getting as has been evidenced throughout the highly successful Atlantic City meeting just closed.

While some of this increase of interest in the commercial side of central station management is undoubtedly attributable to the rude awakenings caused by municipal ownership agitation, and its dire results, all over the country, much more may it be credited to the splendid campaign work done by the technical press, the Co-operative Electrical Development Association, and the co-operating advertising agencies, in presenting this subject to the central station manager's thought and attention during the past year.

The Curtis Advertising Company, Detroit, Mich., have been especially active in this work, and the interest which centered around their booth and exhibit in the convention hall during the N. E. L. A. meeting, was sufficient proof of the forcefulness of the campaigning which this live advertising agency has been conducting during the past few months.

At a convention at which so great a share of the program and discussion was devoted to the consideration of Business Getting (in contrast with previous programs where technical problems and their solutions have been always so prominent), it was but natural that the exhibit of the Curtis Advertising Company should receive a very unusual amount of attention and interest.

This company has done, and is doing, a great deal of very efficient work in arousing central station management throughout the country to the need for greater activity in new business getting than has characterized central station practice in the past, and their efforts in this direction should be commended and "boosted" by all who are interested in the growth of the electrical industry.

The Curtis Advertising Company, makes a specialty of planning and preparing educational advertising suitable for the central station to issue through the mails to lists of people whom it might reasonably be expected to interest in using electricity for light, heat, or power.

The following members and representatives of the Curtis Advertising Company, were present at the convention: Mr. Fred A. Curtis, President; Mr. C. H. Johnston, Vice-President; Mr. Chas. A. Parker, Secretary-Treasurer; Mr. Norman Miner, Special Representative.

The Trumbull Electric Manufacturing Company, of Plainville, Conn., has just issued a new 100-page catalog of its electrical wiring material and specialties, which will be sent to any central station upon request.

The De La Vergne Machine Company, of New York, has just issued a new 82-page catalog describing the mode of operation of the "Hornsby-Akroyd" oil engine and giving illustrations and short descriptions of the more recent installations of these engines. The "Hornsby-Akroyd" oil engines are very well known, there being over 14,000 of them in operation. The popularity of these engines is explained by the extremely low cost of power which is from ¼ to ½ cent per B. H. P. hour.

G. M. Gest, the expert subway contractor, of New York and Cincinnati, has closed a contract, through his New York office, for the construction of 500,000 feet of conduit for the Toronto Railway Company, at Toronto. This will complete the subway system for that company, and will give it one of the most complete underground conduit systems of any railroad.

The Weston Electrical Instrument Company, Waverly Park, Newark, N. J., have this year taken their Mr. Caxton Brown into the Newark factory, as secretary of the company and sales manager; and in his place, have put Mr. Stanley Brown as manager of the New York office.

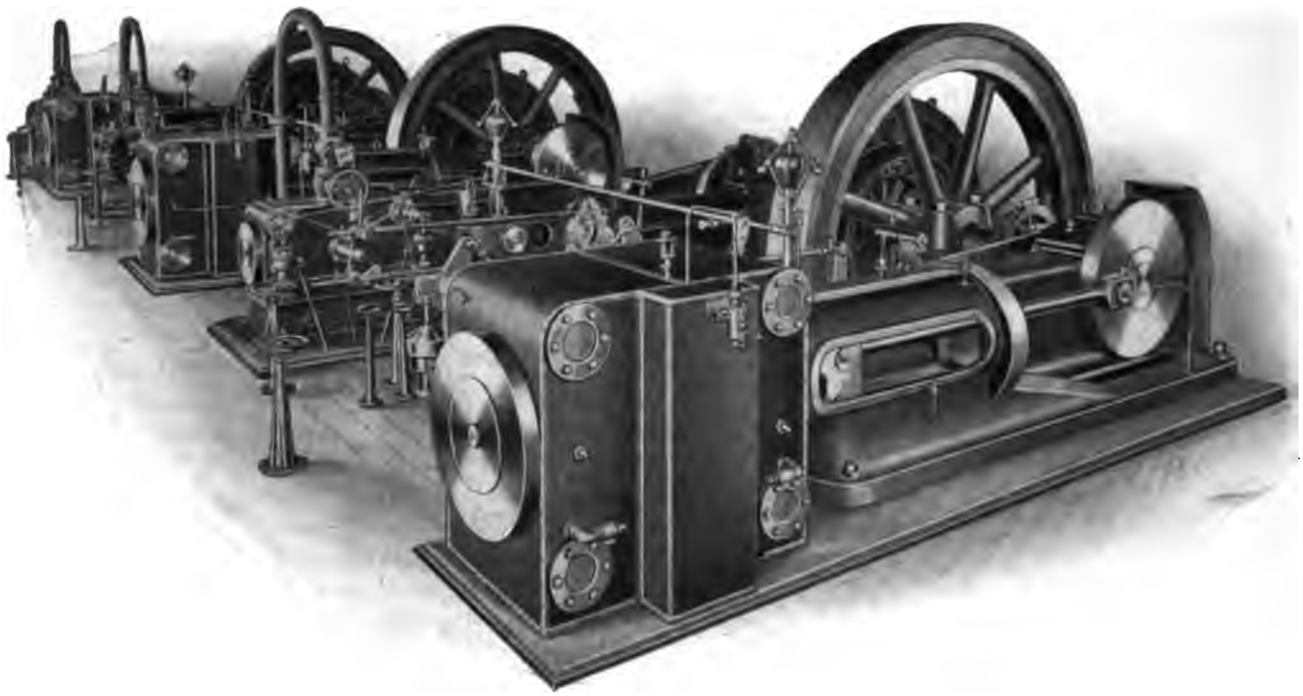
In connection with this office, there has been installed a repair department, whose duty it is to take care of the repairs in the metropolitan district, and particularly to look after emergency calls.

This new feature has been very warmly welcomed by the many users of Weston instruments in New York City, and has enabled the manufacturer to insure a higher degree of satisfaction to his customers.

The company are very much pleased with the present instrument outlook, and are exceedingly busy preparing new models for measuring apparatus to meet the wider demands of modern electrical requirements.

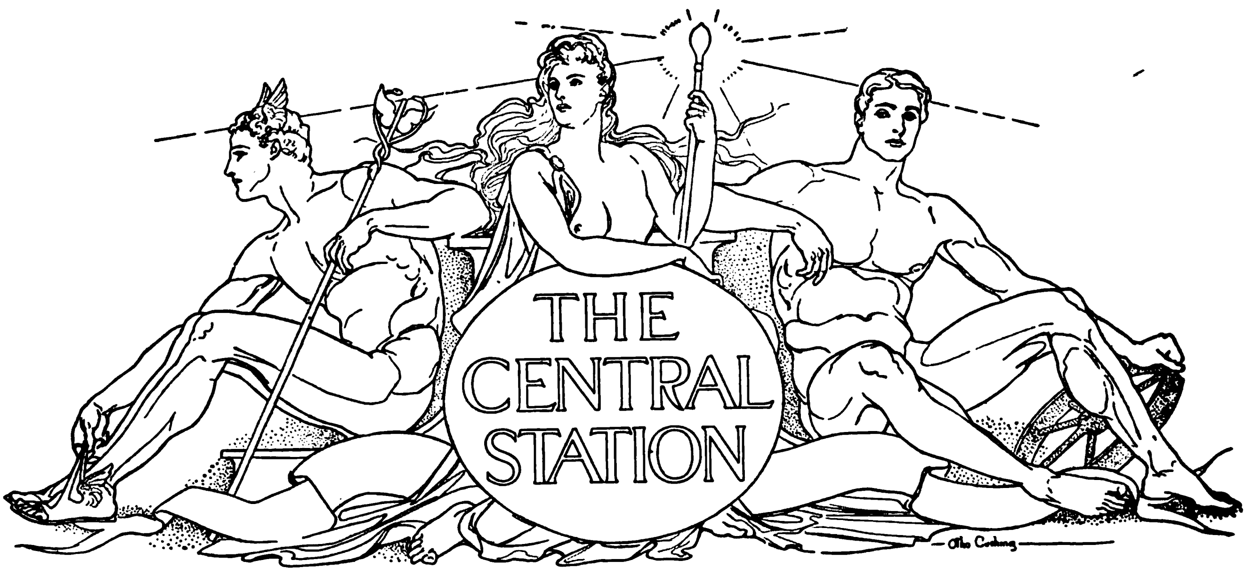
McKenney & Waterbury Company, 181 Franklin corner Congress street, Boston Mass., have more orders for lighting hotels and summer cottages, with gas and electric fixtures, than ever before in the history of their business.

The Murray Iron Works Company, of Burlington, Iowa, manufacturers of the famous Murray-Corliss engines, high pressure boilers, and installers of complete power plants, have just issued their new catalog No. 56, which is one of the most elaborate, best illustrated and comprehensive catalogs ever published. This catalog is nine by eleven inches in size, and consists of seventy-two pages of the highest grade coated paper. The half-tone work and wax plate line drawings illustrating their engines, boilers and feed-water heaters are an education in themselves of the mechanical construction and detail of this well-known product. The accompanying cut is a sample of the illustrations contained in this catalog, and shows a plant of three of their twenty and forty by forty-eight inches cross compound, direct connected engines. The Murray-Corliss engines are complete with four different kinds of frames to render them adaptable to all services, the rolling mill type of frame being considered the best yet designed, and which is covered by patents in the United States. The Murray-Corliss engines and high pressure boilers described in this catalog have become one of the most prominent standard makes for central station service in this country.



THREE 20 AND 40 BY 48 INCHES, MURRAY-CORLISS CROSS-COMPOUND, DIRECT-CONNECTED ENGINES.

Among those who have purchased White Star Oil Filters recently are: Sears, Roebuck Company, Chicago; Mandel Bros., Chicago; American Steel & Wire Company, Waukegon, Ill.; Youngstown Sheet & Tube Company, Youngstown, O.; Boston Elev. Ry. Company, Boston Moss.; Merchants' Ice & Coal Company, St. Louis, Mo.; City Electric Light Plant, Easton, Pa.; Utica Industrial Company, Rome, N. Y.; Northern Manufacturing Company, Detroit, Mich.; Mutual Light & Water Company, Brunswick, Ga.; Indiana County Gas Co., Hambleton, W. Va.; Elk Lick Lbr. Company, Hambleton, W. Va.; New England Cotton Yarn Company, New Bedford, Mass. One of the chief features of the White Star oil filter is the ease with which it may be taken apart and cleaned without interrupting the operation in purifying dirty oil. This and its many other advantages are shown in booklets which the Pittsburg Gage & Supply Company, Pittsburg, Pa., will be pleased to mail all engineers.



DEVOTED EXCLUSIVELY TO THE INTERESTS OF ELECTRIC LIGHTING AND POWER STATIONS.

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Central Station Light, Heat and Power Principles.

BY NEWTON HARRISON.

Elements of Direct Current Power.—A marked difference exists between direct and alternating current power, both as regards its fundamental character and constituent elements. The measurement of such power is made with a volt and ammeter, or a wattmeter, as the case requires. Its elements are potential and current coincident in effect, in contradistinction to what may occur with an alternating current. Direct current, as its name implies, is a current flowing directly from pole to pole, without reversal. It is readily understood, however, that the so-called direct current is not originally produced or generated as such. On the contrary, the direct current generator inherently by its very construction produces an alternating curent (Fig. 1), the individual waves of which, however, are selected with reference to their direction by means of the commutator and brushes. One group of waves in one direction and the other group of waves in the other direction are systematically selected, and thereby issue from one brush or set of brushes, or the other brush or set of brushes, resting on the commutator. The point, therefore, to be particularly noted in a consideration of direct current generators is the fact that they are alternators, though not permitted to operate in practise as such. All direct current machines, with the one exception of unipolar types, are alternating current generators. It is only, as previously stated, the commutator and brushes (Fig. 2), an invention of a definite current rectifying purpose, which direct the one set of waves into one set of brushes and the other set of waves into the other set.

Elements of Alternating Current Power.—The elements of alternating current power represents a relationship which, under certain conditions, appears paradoxical. For instance, reference is made to the fact that one element of power may be regarded as separated from the other. A given potential may not be in exact coöperation with the current it has developed through a given resistance. The idea that the elements of power, volts and amperes are not necessarily associated with each other in the manner with which they are usually regarded, is no bar to the proper consideration of their ultimate coöperation. The conditions existing in an alternating current, however, may be such that one element may be separated from the other to a degree

depending upon: the alternations of the current, the amount of self induction in the circuit, and the resistance. The elements of alternating current

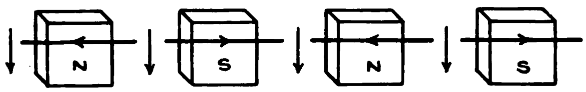

FIG. 1.—ALTERNATING CURRENT PRODUCED IN A DIRECT CURRENT GENERATOR.

power (Fig. 3), in other words, are not necessarily coincident, and for that reason cannot be so readily related to each other, as in the case of a direct current. The mere product of volts and amperes

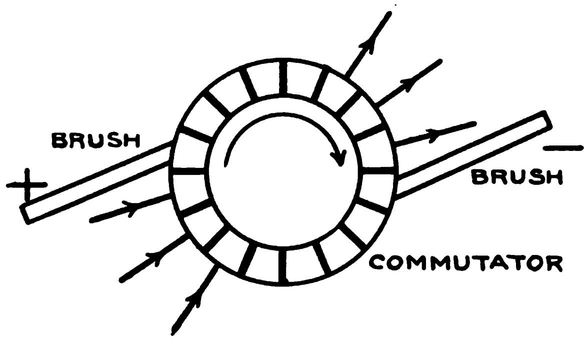

FIG. 2.—COMMUTATOR, ARMATURE CONNECTIONS AND BRUSHES, WITH + AND — CURRENTS BEING COLLECTED AT THE BRUSHES.

is not enough, for it is evident that this product must be modified by a figure expressing the degree to which the two elements of power act conjunctively. In other words, to recapitulate, there must

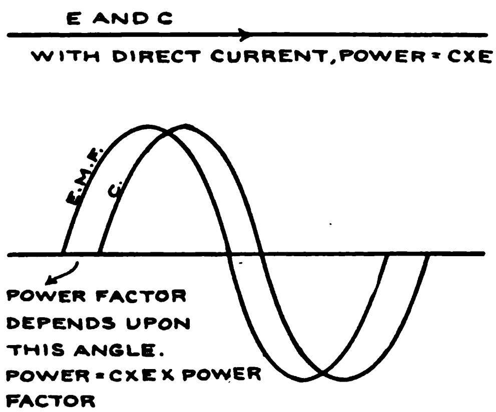

FIG. 3.—COMPARISON OF CALCULATIONS OF D. C. AND A. C. POWER.

be not only a product of the volts and amperes to consider, but a power factor as well. Direct current power is thus only a product of volts and amperes as they appear in the respective meters. Alternating current power is the product of volts and amperes, and that particular power factor or percentage, which is the result of peculiar circuit conditions.

Types of Current.—There are, in commercial use, certain types of current whose application to light, heat and power purposes is dependent upon the

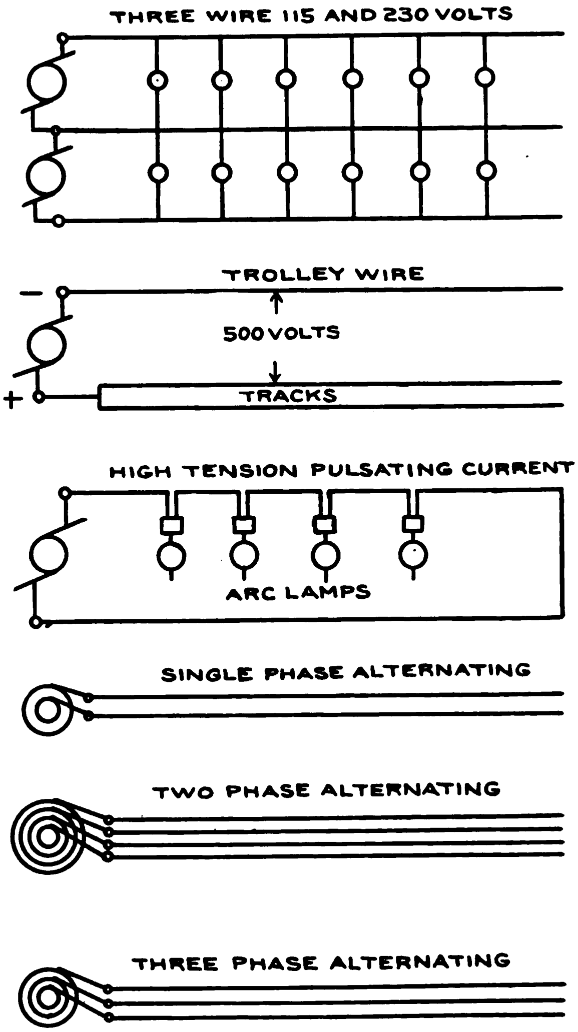

FIG. 4.—DEVELOPMENT OF SYSTEMS DUE TO TYPE OF CURRENT.

system (Fig. 4) which exists through their use. For instance, to enumerate: there is direct current, subdivided into two types, representing the continuous current of 115, 230 and 500 volts for electric lighting and street railway service on the one hand, and the pulsating current used for high tension arc lighting on the other hand. Alternating current may be readily considered as consisting of three

forms of power as seen in everyday service. First, the single phase alternating current form; second, the two phase alternating current form; and third, the three phase alternating current form. The direct

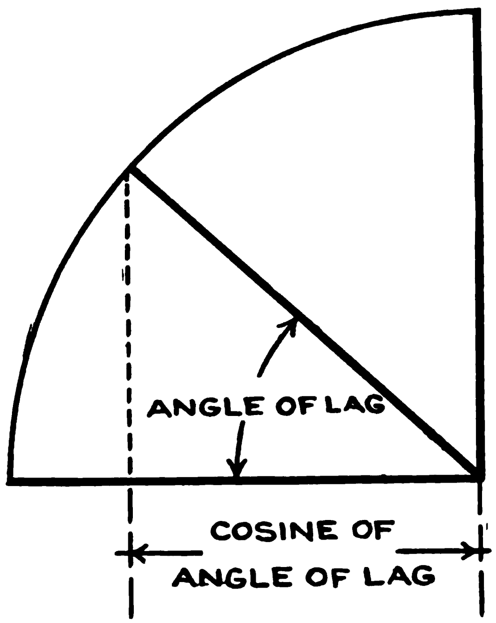

FIG. 5.

current three-wire system may be duplicated with two alternating currents of the same pressure. Constant current arc lighting is also done by transformers, whose function it is to transmit current to arc lamps at a constant value. Where two and three phase currents are applied, however, the class of machinery employed, as well as the system involved, are characteristically distinct from that of any other system. The study of central station and power house problems, is in many respects as much an investigation of conditions calling for a particular kind of current as an analysis of the requirements in the way of system, pressure, machinery and line equipment. In other words, systems are as much the outcome of the use of certain types of current as types of current are now regarded as the necessary consequence of certain economic conditions.

Apparent and Real Power.—Alternating current practise is illustrative of the necessity for a distinction between real and apparent power. Real power is that power actually operating in a circuit, in spite of the volts and amperes recorded. Apparent power is that power seemingly in a circuit, as indicated by the volts and amperes recorded. The difference is entirely due to influences operating to separate the power elements. In practise, the term power factor is indicative of the extent to which the real and apparent power differs. In theory the power factor is simply the cosine (Fig. 5) of the angle of lag in the current. An explanation of the angle of lag is necessary in order to show how it increases and decreases. It is readily evident that the greater the influences causing an angle of lag the greater the cosine, and the greater the difference between the real and the apparent power. On the other hand, the more ineffective the influences otherwise causing an angle of lag, the less the cosine of the angle of lag, and the more nearly the two elements of power act conjunctively. Real power and apparent power are simply cases of where something is operating, or tending to operate, in the circuit in such a manner that either the volts and amperes are not affected as far as their mutual relationship are concerned, or they are so affected that this mutual relationship is partly destroyed. The power factor is therefore a figure representing the percentage of the real power actually in the circuit. In this respect, the cosine of the angle of lag or the power factor is merely indicative of the ratio between the real power of the circuit and the apparent power which may be readily recorded.

Angle of Lag.—An alternator producing a current which reverses in direction every instant. may

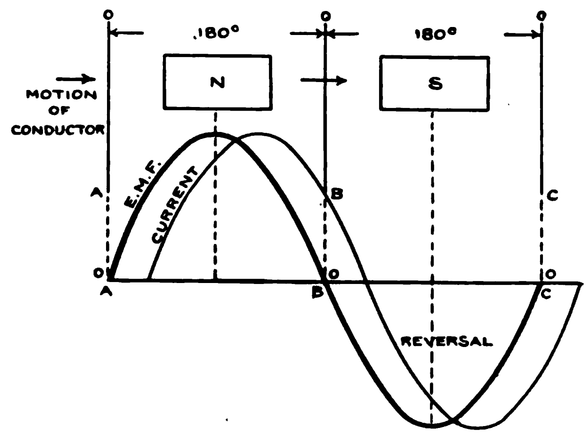

FIG. 6.—RISE AND FALL, REVERSAL, RISE AND FALL OF THE E. M. F. DUE TO A CONDUCTOR PASSING A N AND S POLE AS SHOWN AT A A, B B, AND C C.

or may not be producing volts and amperes simultaneously. By this is meant that the self induction may be great, in which case the lag will be great; or the self induction may be low, in which case the

lag will be little. The idea of associating the degree of separation between the electro motive force and current, with an angle, is due to the peculiar basis of alternating current theory. This basis is that of regarding the complete rise, fall, reversal, rise and fall of the current as consisting of two sine waves (Fig. 6), each of which is called 180 degrees. The idea may be well represented by a conductor passing a N and a S pole consecutively. When entering the field of the N pole the E. M. F. rises to a maximum and then falls to zero. When entering the field of the S pole, the E. M. F., acting in a reverse manner, rises to a maximum and falls to zero. There are therefore three zeros to consider in all: when the conductor enters and leaves the N pole and from that last point to that at which the S pole ends. These zeros are actually zero values of the E. M. F. and current. From the beginning until the end of the first wave, due to the conductor passing the N pole, 180 degrees, are embraced. From the beginning until the end of the second wave, due to the conductor passing the S pole, 180 degrees are embraced. It is evident that the E. M. F. must rise and fall and reverse, and rise and fall again, as may be discovered by elementary considerations. The question, however, of importance, is that relative to the current under these conditions, an examination of which will discover the angle of lag.

How the Angle of Lag Originates.—There would be no lag in the electricity if it were not for the influence of lines of force upon the circuit carrying the current. Even the alternator armature is not free from inductive or reactive influences. The point to consider, however, is the degree to which the lines of force of the circuit, or in fact any circuit, react. Turning to elementary considerations, it is to be noted that the lines of force of a circuit produced by an *entering* current oppose its E. M. F. When the current is *leaving*, these lines of force tend to hold it back, or apparently preserve its E. M. F. But in the case of a current rapidly entering and leaving and reversing, and repeating this operation, the net effect is a distinct lag of the amperes behind the volts. The current, so to speak, follows an instant after the E. M. F. When the E. M. F. is in a circuit, but on account of the inductance of that circuit cannot instantaneously send the current through its ohmic resistance demands, it is evident that the greater the lag or retardation of one behind the other, the less effective power is at hand. An armature, therefore, with great inductance will generate a current of much lag; and an armature of less or no inductance will generate a current of little lag. It is a simple matter, on the same basis, to measure the lag in the same terms, namely, an angle. The cosine of this angle is the power factor in practise. If the angle is 0 degrees the cosine is 1 or 100 per cent.; if the angle is 90 degrees the cosine is zero. Between these two limits of no degrees and 90 degrees the cosine varies from one to nothing, or the power factor may be 100 per cent. or zero per cent.

Prepared for THE CENTRAL STATION by Colin P. Campbell, Attorney.

The Question of Negligence Where Horse Was Killed by Wire Which Had Hung Over Feed Wire Eight Minutes.

This case, while it did not involve a power company, at the same time is interesting upon the question of the length of time a wire may hang over a highly charged feed wire without negligence being included therefor. The facts were that the defendant operates its railway by means of an overhead

trolley. About half past five on the 20th day of August, 1905, the plaintiff was driving a truck with two horses along defendant's track, when one of the horses came into contact with the wire which had by some means been thrown over and then hung from defendant's feed wire. The horse received an electrical shock from which it immediately died. The wire was not of a kind used by defendant and evidently was no part of its equipment, and the circumstances pointed irresistibly to the conclusion that some mischievous person had thrown this loose piece of wire over defendant's feed wire, and left it dangling there. There was no evidence how long the wire had been in this position, except that one of defendant's motormen said that he had passed the spot eight minutes before and had not observed it. Under these circumstances there was no evidence of defendant's negligence to submit to the jury. We think, also, that the justice erred in withdrawing from the jury altogether any question as to plaintiff's negligence. While he had a right to assume that the road would be unobstructed, he was not wholly relieved from the obligation to be reasonably vigilant in watching for unexpected and unusual obstacles, and it was at least a question for the jury whether, if he had been so vigilant, he would not have seen the wire before he reached it.—Jones v. Union Ry. Co., 98 New York Supplement, 757.

NEGLIGENCE IN HIGHLY CHARGING AN ELECTRIC LIGHT WIRE CAUSING AN INJURY TO ONE WHO TOOK HOLD OF THE WIRE ABOVE THE BULB.

In this case suit was brought to recover damages for the death of plaintiff's husband through negligence of the defendant, resulting from his coming in contact with a highly over charged wire in the home of deceased at Niagara Falls on the 27th day of September, 1903. The claim of the plaintiff is that the wires used for supplying light to the deceased had become overcharged through the defendant's negligence, and the deceased, being unaware of this dangerous condition, took hold of an extension cord, at the end of which was an electric light bulb, used for lighting the cellar or basement of the house, and was killed.

The Court said.—That Loren T. Witmer came to his death by coming in contact with a wire overcharged with a deadly current of electricity is scarcely disputed. Neither is the fact seriously controverted that ordinary the current was not deadly, or even dangerous. The incandescent electric lighting was used in this house. The incandescent circuit voltage was about 2,200, carried on two primary wires, which distributed the electricity about the city. Transformers were placed in various parts of the city, which reduced or stepped it down, as it is stated, from a voltage of 2,200 to about 106, and at this reduced voltage it was used for lighting the houses and other places. Less than 500 voltage is, under ordinary circumstances, not dangerous to human life, so that, if the deceased came to his death by coming in contact with a current of electricity, it is reasonably certain that the current exceeded the usual house lighting voltage.

No claim is made that the defendant is liable for the wiring in the house, for that was not done by the defendant. The sole claim of the plaintiff is, that the defendant, through its want of care and attention in respect to the matters which will be adverted to a little later, was responsible and became liable for the consequences resulting from the over charged condition of the wires in this house, which caused the death of the deceased, and that question is the serious question presented by this appeal.

It appears that on the early morning of September 17th, 1903, between two and three o'clock in the morning, an unusual buzzing noise was heard. The deceased was awakened by his wife and evidently determined that the disturbance was due to the electricity, for he went upstairs and turned off the entrance switch connection. His wife warned him to be careful and he replied that there was no danger; that there couldn't enough come into hurt anybody; that it would blow out the transformer before it would come in. After turning off the switch they proceeded on their way downstairs, and the buzzing noise came on again. The cellar indicator in the dining room showed that there was light in the cellar. He started down cellar. The noise continued about a second. It had ceased before he opened the cellar door. On his way down he struck a match. The cellar was usually lighted by an electric bulb attached to the end of a cord. The cord was about seven or eight feet long, and when not in use was hung up. He took hold of the cord, lifted it towards him; the match was going out. His wife said, "I will go and get a light for you." After she had turned and gone for the light, the buzzing sound came on again, the bulb lighted up, and at the same time the deceased groaned and fell. She was at the head of the cellar stairs when she saw him take hold of the wire. His wife and sister picked him up and

put him in a sitting position. His wife went for a doctor and at her return the deceased had been carried upstairs by his father and his sister; they were working over him, but he was, evidently, dead, for they were unable to revive him.

The high tension wire of the arc system carried a voltage of 7,500. That this current was communicated in some measure and by some means to the wires of the residence of the deceased is reasonably certain; indeed, both parties so claim. The serious question is, whether it was done, as is claimed on behalf of the plaintiff, by the proximity of the arc and incandescent wires and their sagging or by the limbs of a tree through which the two wires passed connected them, thus sur-charging the incandescent wires, or both; or whether, as is claimed on behalf of defendant, the fire alarm wire fell upon the high tension arc wire, conveying the current in some manner to the telephone wire, and then from the telephone wire to the incandescent wire, and eventually finding its way to the home of the deceased. If the latter, then under the rule of law adopted by the learned trial court, a recovery against the defendant cannot be sustained, for such was the charge to the jury. It seems reasonably certain that the fire alarm wire fell upon the high tension arc wire, or in some way the current from the high tension wire was communicated to the fire alarm wire, but it is still open to doubt as to whether this overcharged current was communicated to the telephone wire, and from the latter to the incandescent wire, and from thence into this house. It was a stormy night and high winds prevailed. The alternate buzzing and the light coming on momentarily and then disappearing would seem to indicate that there was an alternating current transmitted to the wires in this house. The defendant contends that this same condition was apparent on the fire alarm system, as testified to by the person in charge, at about the same time that the accident occurred; thus lending credence to the claim that the current was not only alternating, but may well have been caused by the swaying motion of the wires, thus causing intermittent contact, or proximity of wires sufficiently close to communicate the current from the high to the low tension wires. The defendant contends that this intermittent current was produced by the swaying of the telephone wire by the wind, while the plaintiff contends that it was the swaying motion of the other wires and the intermittent contact between the two wires communicated by the limbs of the trees which were being swayed by the wind. Witnesses were called upon both sides testifying to what they observed before and after the accident the reference to conditions in the trees and on the wires and transformers and other conditions which might throw some light upon the question.

Without going into the details of the testimony, we think the evidence presented a fair question of fact for the jury, and finding thereon favorable by them to the plaintiff's claim afforded the grounds for the further finding that the defendant was not sufficiently careful in maintaining its wires and system, and did not have that regard for the safety of human life that the law requires shall be observed in handling so dangerous an agent as electricity. The rule, as charged by the learned trial court, that the defendant was required to use reasonable care in constructing and maintaining its system, and to prevent the secondary system being charged with a high voltage current, was as favorable to the defendant as it could ask. Nor can it be said that the evidence showed that the deceased was not reasonably careful. It is true the extension cord may have rested on the cellar bottom, and the insulation so worn that it afforded an easy way for the current to reach the ground, and that the deceased knew that, and was reasonably familiar with the dangers of electric current; but it must be remembered that ordinarily the house wires did not carry a sufficiently strong current to make it dangerous, so that from the lack of insulation or for any other reason would it be dangerous to take hold of this extension cord. Under all the circumstances it was a question of fact for the jury to determine whether the deceased was free from contributory negligence.

The contract under which defendant supplied light to the deceased contained the following provision:

"In case the supply of light should fail, whether from natural causes or accident, in any way, this company shall not be liable for damage by reason of such failure, nor shall it be liable in any event for damage to person or property arising, accruing or resulting from the use of the light.

It is contended by the defendant that this provision exonerates the defendant from liability for damages, even if caused through its own negligence. We cannot assent to this claim. Contracts of this character, to warrant such a construction respecting the negligence of a party in omitting a plain legal duty, must do so in terms and expressly provide to exempt from such liability.

As regards the statement made by the deceased to his wife when the switch was being turned off, stating that there was no danger, that a sufficient current could not get into the house, in response to her statement asking him to be careful, we think they constitute a part of the res gestae, and were competent.

We conclude that the verdict of the jury should not be disturbed, and that there are no errors requiring a new trial.—Witmer v. Buffalo, etc., Electric Co., 98 New York Supplement, 781.

The Law Relating to Electricity, Central Stations and Power Companies.

II.

FRANCHISE AND POLE RIGHTS. FRANCHISE CONTINUED.

Last month we left this discussion at the subject of franchises. A franchise is necessary to electric light and power companies for two reasons. First, for the purpose of enabling them to erect poles or string wires in streets and across the property; and, second, for the purpose of enabling them to excavate the streets and public property for the purpose of putting down conduits. In fact, the franchise of power and light companies are the most valuable part of their assets. It has been the practice very generally in this country until recent years to put these wires and poles along public highways, along railroad rights of way, or in some similar position. And it is not until comparatively recently that light and power companies have been stringing their lines upon their own right of way. The right to erect poles and string wires in streets comes from the city in the main, but there are also private rights to be considered. Of course, it goes without saying that private parties have no right to place such an obstruction as a pole in the public streets in the city without the consent of the municipality. Neither have they any right to place such poles in country highways without the consent of the proper authorities. The highways are places of public travel designed for that purpose primarily, and the public have the right to use the entire extent of the highways for purpose of travel, not alone the principally traveled portion, but the margins as well. And poles, aside from possibilities arising from the falling of wires and of poles, are a menace to public travel. They may not, therefore, be placed in highways or similar public grounds, without the consent of the municipality or of the state or of the proper authorities, and this consent is ordinarily called a franchise.

RIGHTS AGAINST ABUTTING OWNERS.

Now the question arises, having secured this franchise, what rights have the power companies as against the owners of property adjoining the highway. This question arises because of the fact that generally speaking throughout the country it has been held that the land upon which highways are laid out still remains the property of the adjoining owners, subject only to the right of the public to use the strip of land known as the highway for the purpose of public travel. This right of the public is generally called an easement. And this easement right is universally held where the court agrees to the proposition that the title to the land belongs to the adjoining owners to embrace every right which the public enjoys. The performance of acts on this strip of land not connected with public travel has universally been held to constitute an additional servitude and a trespass of the rights of the adjoining owners. For example, to quote extreme cases: One who stops in a highway adjoining a man's property to abuse the owner of the adjoining property, has been called a trespasser. So also one who fishes in a private stream from a bridge in the highway is a trespasser. Great struggles have taken place in this country on various other matters as to whether or not the erection of telegraph and telephone poles, the construction of street railways, of sewers, the laying of water mains and the like, constitute an additional servitude; and these questions have in the main been held against the land owner, and it is the rule in this country now by the weight of authority, if not by the universal consent of the courts, that the construction of a street railway, the erection of telegraph and telephone poles, together with the pruning of trees, the laying of water mains and sewers in streets, are not additional servitudes. Even in jurisdiction like the State of New York, where in the city it has been generally held that the adjoining owners own simply to the street margin and not to the center of the road, rights have grown up out of the elevated railway system called rights of adjacency, which depend for their enforcement upon the principle that one is entitled to enjoy his property free from intrusion from the public streets warranted by the public authorities, which inter-

fere with his comfort and safety and with his enjoyment of the property. A distinction has also been observed among the cases regarding the boundary between the rights of adjoining owners and the public, in the country and in the city. That is, adjoining owners in the city are required to submit to a great deal more adverse use of the street than are those in the country, and in the main the courts merely permit them the right of free access to and from their property.

RIGHTS TO ERECT POLES AND LAY CONDUITS.

Having previously gone over these principles, let us see how they have been applied. First, upon the question whether or not the erection of poles and the stringing of wires is an additional servitude as against the owner of abutting property. It must first be borne in mind that under all the authorities a light and power company has no authority to erect its poles in such manner as to discommode the abutting owner, nor so as to unnecessarily interfere with his property.

Tiffany vs. U. S. Eluminating Co., 19 Jones & S. (N. Y.), 280.

In some of the states general authority has been given light and power companies to use highways for the purpose of erecting poles and stringing wires. This, however, does not give the company the right absolutely, but requires the company to exercise the rights so granted subject to the police power of the municipality, in which the streets and highways lie, and to so place their poles and string their wires as they may be directed by local authorities to preserve the public interests.

Monongahela vs. Monongahela Electric Light Co., 12 Pa. Co. Ctr., 529.

Nor will a statute providing that the Mayor and Aldermen of a municipality through which an electric line is to pass, shall designate where the poles shall be erected, be constructed in such a way, in view of the local character of the company, of the dangers arising from their lines to travelers and from the other demands for the use of the street by the general public, as will compel action of this kind upon the part of municipal authority.

In Brunson vs. Albion, 92 N. W. Rep., 721, it was held that poles and wires generally permanently and exclusively occupying portions of a public street or highway, constitute an additional burden, for which the abutting owner is entitled to compensation in case he is damaged thereby, even though the company erects the poles and wires under a franchise from the city.

II. Modern Central Stations.

Swiss and German Belt-Driven Plants.

By Frank C. Perkins.

In many small towns in Switzerland as well as in Germany electric stations are in operation using belt driven machines either operated from counter shafting on account of various combinations of units being desired, or belted to gas engines as noted in the accompanying illustration (Fig. 1) Elektrizitätswerk Quedlinburg. The accompanying illustration (Fig. 2) shows the interior of the Schonthal central station for supplying current for both lighting and railway service, steam engines being used for driving the counter shafting as indicated, the switchboard in the background being so arranged that various unique and interesting combinations of these electrical generators can be made in connection with the Weidest hydro-electric central power station whose location is indicated on the accompanying map (Fig. 3). When the hydro-electric plant during period of low water and heavy traffic, is insufficient for supplying the necessary current for operating the Altstäten-Berneck electric railway noted in the accompany illustration (Fig. 4), the Schonthal central station acts as a reserve power house supplying current for lighting purposes for the town during the night as well as for railway service during the day.

The Quedlinburg electric plant, noted in Fig. 1, supplies direct current of 2 x 220 volts for the city service, a three-phase alternating current, primary 3 x 3,000 volts, secondary 3 x 500 volts for power service, and 3 x 110 volts for commercial lighting distribution.

In this plant there is a 130 horse-power gas engine operating at a speed of 170 to 185 revolutions per minute and driving by belt transmission a 90 kilowatt direct current dynamo constructed by the Siemens-Schuckertwerke, of Berlin, Germany. An-

other gas engine constructed by the Gasmotoren-Fabrik Deutz, near Cologne, Germany, operates a direct current dynamo of 90 kilowatts and a three-phase alternating current generator of the same capacity. There is also installed in this plant a direct current—alternating current transformer of 40 kilowatt output as well as a motor-generator of 31 kilowatts for use in storage battery charging.

dest station when the electric railway traffic is heavy between Alstätten and Berneck on market days. The following combinations may be employed to advantage with these plants:

1st. The Weidest station may supply current for the railway alone, the direct current generator working in parallel with the Schonthal storage battery plant; the alternator supplying the necessary

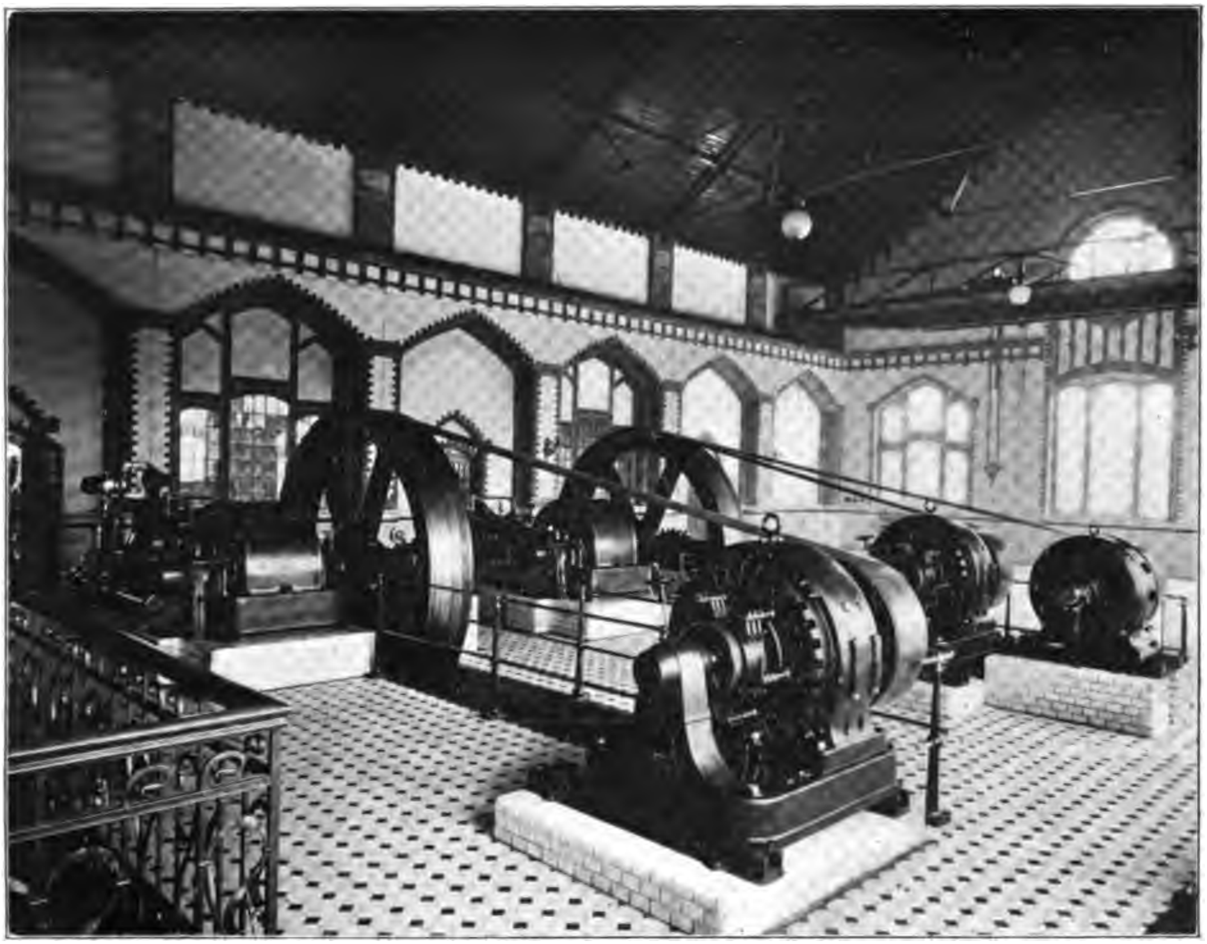

FIG. 1.—QUEDLINBURG CENTRAL STATION.

This is a typical gas engine station of the smaller type, as installed in small German towns.

A power transmission line has been constructed from the Weidest hydro-electric station to Altstätten, as shown in the accompanying map (Fig. 3), and the Schonthal central light power station noted in Fig. 2 supplies current for both lighting and railway service, acting as a reserve plant for the Wei-

village lighting current when the consumption is normal. 2nd. If the current supplied by the alternator of the Weidest station is not sufficient for lighting during heavy load, the reserve alternator at the Schonthal central station can be run in parallel in the Weidest alternating transmission line. The second alternator may be operated by the steam engine or driven by the direct current motor from

the railway line supplying still more alternating current lighting energy.

3rd. If for any reason the alternating or direct current generator at the Weidest station is out of order, it can be replaced by the corresponding machine at the Schonthal central power house.

4th. When required the d. c. generator of the Schonthal central station can be operated by the alternator which may act as a synchronous motor, the necessary a. c. for the motor being supplied by the Weidest station. The a. c. generator which is to act as synchronous motor must, however, first be started by the d. c. machine from the accumulator charge until up to synchronism when it will operate well as a motor, the direct current machine supplying current for the railway line.

5th. The two direct current machines in both stations may be operated in parallel with the storage battery on the railway system during heavy traffic.

The capacity of the storage battery plant which is used as a railway regulator at Schonthal is 60 ampere hours, 270 cells being employed. The normal output is 60 amperes, but 120 amperes or 180 amperes may be used for short periods. The generators supply a steady output corresponding to the average load and the batteries take care of the peak of the load in starting cars and on heavy grades, receiving current back from the line when loads are light.

The transmission line from the Weidest station to the Schonthal power house is 1,500 meters long and consists of two conductors of 5 mm. in diameter for the a. c. and two conductors 8 mms. in diameter for the direct current. The poles are placed 50 meters apart.

A most interesting system of railways in Switzerland, known as the United Swiss Railways, has been giving excellent service to the many towns and villages in the Rhine valley for some years, but these were considered hardly up-to-date, and a short time

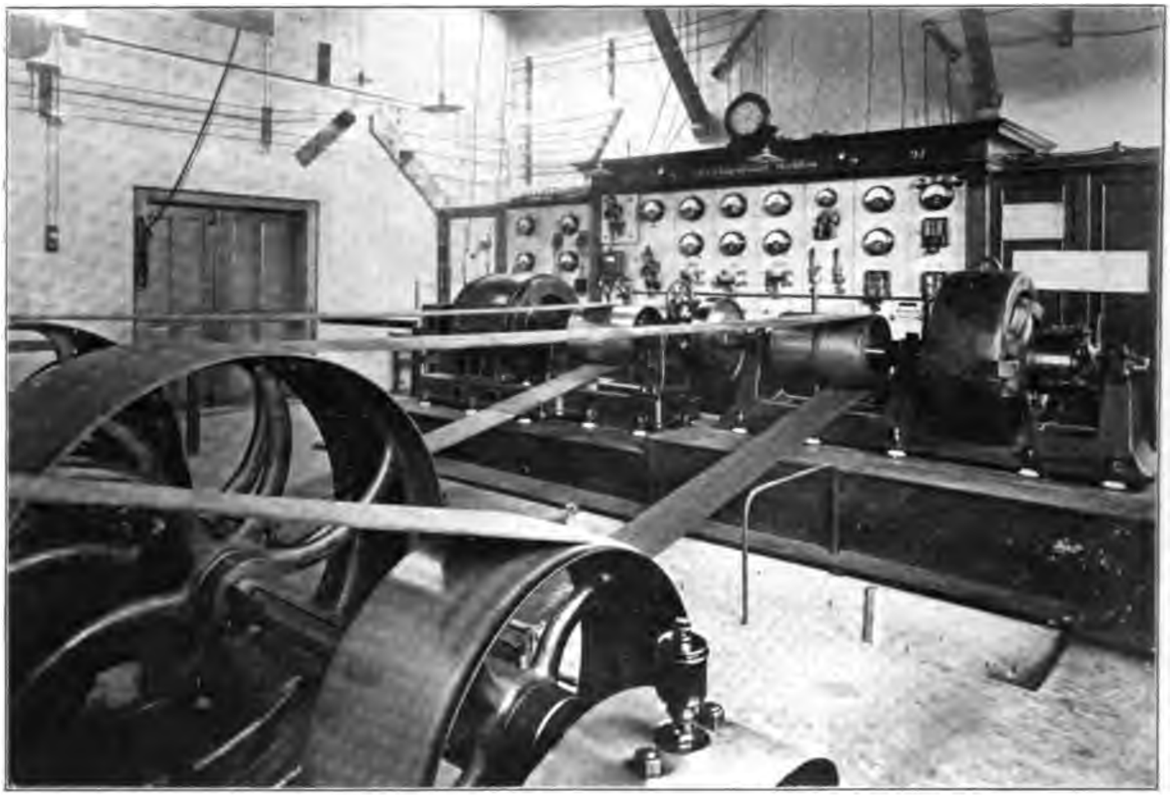

FIG. 2.—INTERIOR OF SCHONTHAL CENTRAL STATION.

ago an electric system of railways was constructed to handle the growing traffic between Alstatte and Harrbrugg.

It may be of interest to consider some of the details of construction of the power plant erected to supply the necessary current. As a good water power was to be had near Altstätten, it was decidea to take advantage of this power plant. for supplying current for the electric road as well as supplying lights for the streets and private use. It was also considered advisable to install steam engines in connection with the hydraulic plant to supply a surplus of power for use on market days, when the traffic was extremely heavy. The installation of the power 180 mms. deep, over which there is a gravel bed 65 mms. thick. The current is supplied to the overhead trolley line by means of feeders from the power transmission line. The line voltage used is 600 volts and the rails are bonded with copper wire 6 mm. in cross section.

The trolley wires consist of copper conductors 8 mms. in diameter carried on insulators with iron arms and wooden poles. The overhead line is separated into two parts supplied with current from the Schonthal switchboard direct. The part of the line on the Berneck side may be operated from either the Weidest power station or from the Schonthal plant.

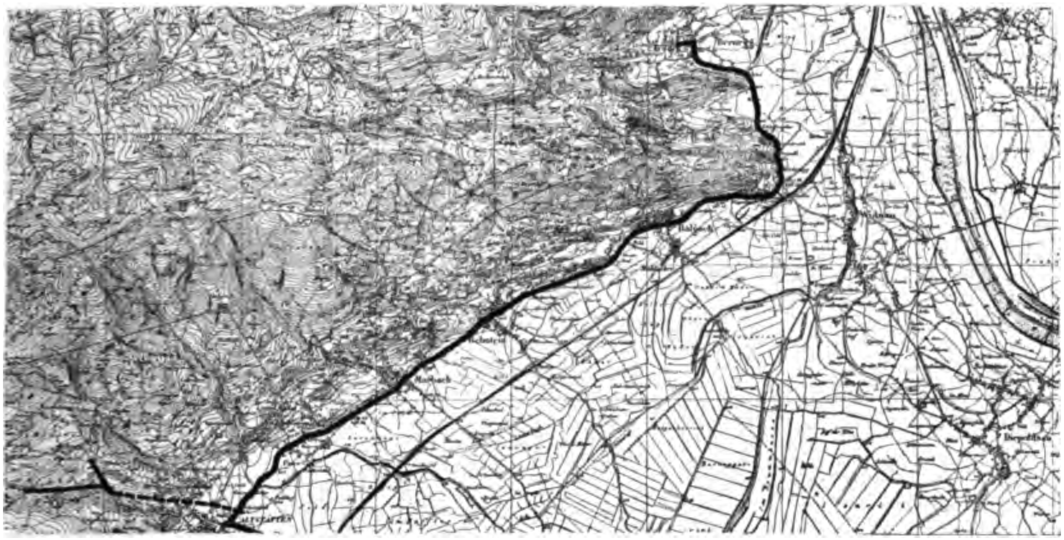

FIG. 3.—RAILWAY LINE FROM ALTSTATTEN TO BERNEGG. POWER TRANSMISSION LINE (DOTTED).

stations and railway equipment was entrusted to the Maschinenfabrik Oerlikon of Oerlikon, near Zurich, Switzerland.

The Altstätten-Berneck electric railway starts at the Berneck City Hall and ends at the Altstätten R. R. station, a distance of 11.6 kms., following the state road. The maximum grade is at Berneck, where for a distance of about 55 meters the grade is 52%, while the average grade is 13.75% and the minimum curve radius is 25 meters. The tracks have a gauge of one meter and all of the signals are automatic in action. The rails are of Hartwig section with a width at base of 109 mm. and a height of 135 mm., the weight being 24.5 kgs. per meter.

The rails rest on a stone bed 200 mms. wide and

There are in operation on this line a number of motor cars, the total length of each of which is 7.5 meters, the width being 2.1 meters and the interior height 2.33 meters. The capacity of these cars is 36, there being seats for 24 passengers. There are smoking compartments in the cars and each is lighted and heated by electricity. The cars were constructed by the Vereinigten Maschinenfabrik Augsburg und Maschinenbau Gesellschaft Nürnburg A. G., and the motor equipment by the Maschinenfabrik Oerlikon. The motors are of 18 h. p. capacity, the armatures being wound with 12 turns in each of the 59 slots, the conductors being 2.2 x 2.8 mms. in cross sections, while the commutator has 118 sections.

The field winding consists of four coils in series each having 120 turns of 3.5 x 4 mms. in section. The total weight of the car is 6,500 kgs. A postal car is provided for carrying the mail to the various places along the lines. The machine shops and repair works are equipped with electrically operated lathes, planers and boring machines driven by direct current from the transmission line. There are from 16 to 21 trips made each day in each direction between 6 A. M. and 9 P. M., and the speed is from 12 to 13.6 kms. per hour.

The two central power stations which supply the necessary current for the railways and lighting of villages are located at Weidest and Schonthal, and both are equipped with alternating and direct current apparatus.

The water power for operating the turbines at the Weidest power plant is obtained from the Brendenbache and the Ebenackerquelle, two streams whose sources are in the mountains, at the foot of which lies the village of Altstätten. The waters from the Brenderbache are collected in a reservoir

FIG. 4.—CAR EQUIPMENT AND OVERHEAD CONSTRUCTION, SHOWING POSTAL MAIL CAR TRAILER.

The line between Altstätten and Berneck is divided into 8 sections, ranging from 1,250 meters in length, and the rates of fare between the villages is 15 centimes (3 cts.), and for each additional section 5 centimes. The line passes through Marbach, Rebstein, Balgach Bad, and Heerbrugg.

The total number of passengers carried per year is about half a million, the cars travelling a total of 151,435 kms. The total income was 77,720 francs, or 51.3 francs per car km., while the expenses were 57,377 francs, or 37.88 francs per car kilometer.

of 1,000 cu. meters capacity and are carried by a pipe 250 mms. in diameter and 1,700 meters long to the power house, where it operates a high pressure turbine directly coupled to the d. c. railway generator. This turbine is of 70 h. p. capacity and operates under a pressure of 15 atmospheres, the fall being 150 meters and the water discharge 55 liters per second.

The water from the Ebenackerquelle is collected in another reservoir 400 meters from the power plant. This reservoir has a capacity of 250 cu. me-

ters and the water is conveyed through an iron pipe 300 meters in diameter to a turbine in the power plant, which is directly connected to an a. c. generator. This turbine was constructed by Escher Wyss & Co., of Zurich, and has a capacity of 100 h. p. under a head of 100 meters and a discharge of 70 liters per second. Both of these turbines operate at a speed of 600 r. p. m.

On account of the desirability of using the water over again by works below the power station, the water from the tail race of the turbines is collected in a large reservoir below having a capacity of 1,400 cu. meters.

The Weidest power station is located 1,500 m. from Altstätten. The first floor of the building is used for the turbines and generators and controlling apparatus, the engineers in charge living in the upper portion. The 100 h. p. turbine mentioned above drives an Oerlikon alternator at a speed of 600 r. p. m. This alternator supplies a monophase current and has a capacity of 66 to 72 kws., the frequency being 50 cycles per second. The primary of these alternators, as well as the secondary windings, are stationary, the machine being of the inductor type. Each half of the stationary armature has 10 slots with 10 double coils, 13 inside and 12 outside turns of copper wire of a cross section of 3.7 mms. x 4.3 mms. The exciting field coil has 546 turns of copper conductor 4.5 mms. x 5 mms. in cross section. The exciter is directly connected to the alternators and has a capacity of 3 kws. and is a bipolar continuous current Oerlikon dynamo.

The compound wound d. c. generator for supplying the current for the electric railway has a capacity of 47 kws., and supply a current of 600 volts pressure, the speed of the machine being 600 r. p. m. The armature core of this Oerlikon machine is 540 mms. in diameter and 360 mm. in width, and has 160 slots, each of which contain five conductors of a cross section of 3 mms. x 3.6 mms. The commutator has 160 segments. The four coils of the field winding have each 4,674 turns of copper wire 1.1 mms. x 1.5 mms. in section for the shunt and for the series 24 turns of bar copper for the compounding 5 mms. in cross section. The two generators are insulated from the cement foundation. The switchboard is 1.35 m. wide and 2.5 m. high and consists of two panels for the generators and exciters, mounted with the necessary switches, cutouts, measuring instruments and rheostats. The lighting of the Weidest station may be supplied from the alternating current high tension current circuit from a static transformer, the current being generated either in this station or at the Schonthal power house.

The Schonthal central power plant is 1,400 meters from the Weidest station, and covers an area of 638 sq. meters. The generator's room contains the two generators which are operated by the reserve engine and boiler plant and belt driven. The engine flywheels are 1,850 mms. in diameter. The boiler heating surface is 37.2 sq. meters and the working pressure is 9 atmospheres, 50 h. p. being developed by this engine at a speed of 120 r. p. m. The high pressure cylinder is 370 mms. in diameter and the length of stroke is 360 mms. The high pressure valve gear is of the Rider type and the low pressure cylinders are equipped with valves of the French system.

The a. c. and d. c. generators are installed with the shafts of each coinciding so that they may be easily coupled together and either may be used as a motor to drive the other or either or both may be driven from the steam engine. The lighting alternator has a capacity of 32.4 kws. and operates at a speed of 750 r. p. m., generating a monophase current of 50 cycles and a pressure of 2,500 volts. Each generator has three bearings and a tight and loose pulley. Each half of the stationary armature winding of the alternator has 8 turns of wire 2.5 x 3.1 mms. in section.

The field coil consists of 780 turns of copper wire 3.3 mms. x 3.8 mms. in section. The exciter of this alternator is also directly coupled to the same shaft outside the main bearing.

The d. c. traction generator is compound wound and has four shunt field coils of 2,397 turns each, the conductors having a cross section of 1.2 mms. by 1.6 mms. The series coils for compounding consists of 20.5 turns of copper conductor 7 mms. x 7.6 mms. in section. The capacity of the machine is 33 kws. The commutator has 152 segments and the armature core is 410 mms. in diameter and 320 mms. in width. It has 76 slots, each containing 12 wires of 2.2 mms. x 2.8 mms. cross section.

The white marble switchboard is equipped with the necessary a. c. and d. c. measuring instruments switches and controlling apparatus on their respective panels. There is also a volt meter for the Weidest current, as well as synchronizing lamps and transformer to aid in coupling the Weidest and Schonthal alternators in parallel.

The Central Station

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Small Central Stations.

A trip through the Hudson River Valley, and then north to Lake Champlain, will be the means of discovering a great many small central stations established in a number of towns in that region. A visit to almost any other section of the United States would be productive of the same conclusion, as regards the smallness and number of central stations in what would seem to be out-of-the-way places.

In some instances consolidation has been effected, and the central station of a larger size thus evolved, supplies its electricity to the smaller centers surrounding it. A very curious fact is to be noted in this respect, and that is the similarity of this state of affairs to what occurs in many parts of Europe, particularly Germany. But whereas the small American central station is apt to stick to steam and the system which it represents, the small German stations have and are undergoing a remarkable transformation in this respect. The small German central stations have taken their cue from the larger, as it were, and have not only installed producer gas equipments, but cut down prices to a ridiculously low figure. The point involved is therefore one which appears in the light of a commercial paradox to some: A small station with its fixed expenses; a complete change in the power supply proper; and yet a price for current representing an exceedingly reasonable figure. We have a few facts to consider in this respect, not so much because a small German central station charges little for current, but because of the fact that their fuel is so scarce as compared with our own, that even with the transformation from steam to gas the price of current remains still low. Allowances can be made for fuel, but it seems that no country in the world can or should have cheaper fuel than our own. The fuel question, however, is not the only one which gives rise to argument. In Germany the prevalent note in all engineering propositions is that of science. It enters into all economic propositions, and for that reason their use of fuel, machinery, and labor is in this respect more advanced than our own. But while making allowances for all this, the point to consider in this country, so many times larger than Germany, is the fact that the smaller central stations are doing a great missionary work. The difficulty of converting people in some localities to the belief in the advantages of electricity is in itself one of the greatest drawbacks. The idea always found in the ultra conservative mind, that something that has not been used need not be used, is the sticker to the advance agent of central stations. The number of small central stations in the United States, however they may or may not be conducted, is in reality a tribute to the enterprise, energy and push of thousands of comparatively obscure sections. They are not the only examples of where success is, as some instances show, dearly bought. But this is not true in any but special cases, such cases which present a battle with ignorance, politics and indifference. On the whole, most of the small central stations are earning a reasonable return on the original investment. They can and will earn more than this, when the necessity for electricity for lighting and heating, as well as power, has become more evident to consumers than

at present. This is only a matter of education, a process as sure in its effects as the passage of time.

What Constitutes Lightning Protection.

Central stations and power houses offer unusual inducements to nature during electric storms. They are the center of a great system of radiating circuits, such as street railway, power transmission, light and power lines. The opportunities for mischief are therefore many, and in consequence unusual precautions must be taken to avoid the evil consequences of sudden disruptive discharges, due to cumulative potentials. The electro static situation in this respect is not one which differs so considerably from what might be expected from a review of the circumstances presenting themselves in such cases. But a knowledge of these circumstances is probably what is apt to be lacking in any instance where a hasty conclusion seems obvious. Any network of wires a short distance from the surface of the earth and insulated from the surface, offers an excellent opportunity for inductive action of an electro-static nature. The presence of a charged cloud overhead is, with respect to the dielectric between it and the earth, a case of a charged and a neutral body, the neutral body, of course, being affected inductively. But though this seems to be in general the case in point, it is not entirely all of the case, because of the variations in potential which occur at different points of the hitherto neutral body.

If the cloud overhead is heavily charged, it may develop a series of heavy potentials, at different points in the system below. The amount of potential at each of these points, before any lightning appears, is of the greatest interest in connection with this subject. Lightning protection in its broadest sense, is not only protection when lightning actually strikes, but protection before it has a chance to strike. To get protection before lightning can strike means draining the lines and station machinery of electricity, to put it plainly, so as to relieve them of any potential that may exist due to condenser action. To present the matter still more clearly, the action of the charged cloud mass above certainly means an opposite electric charge in the earth beneath. Though the insulated wires and switchboard apparatus may be of an opposite charge, it is still evident that at certain points in this system, whatever may be the polarity, whether positive or negative, the electricity will accumulate to a point of tension sufficient, unless relieved, to leap across gaps, enter through insulation to important parts, and perhaps before lightning actually strikes, destroy a certain amount of machinery. While such a case is on its face hypothetical, it is, at best, illustrative of possibilities, and conveys the vital lesson to be learned, namely: that lightning protection is as much protection before as after it strikes. To accomplish this, it is necessary to devise a system which will relieve itself of accumulated potential, as quickly as it reaches a certain point of pressure. Clumsy or obsolete forms of apparatus cannot perform this duty. A careful review of the latest science and theory on the subject, shows clearly that the word protective can have substituted for it the word preventative. Prevention in this sense is only secured by a system in which potential is dissipated as fast as it develops.

Testing Alternating Current Machinery.

The possibility of change in the operation of a smooth running machine is entirely dependent upon the rate of deterioration involved in such continued operation. It might be said with a great deal of truth that insulation in connection with alternating current machinery is of first importance. That it can and will deteriorate is a matter of common knowledge; but it is not so well known that other forms of deterioration may occur and develop ill effects without any apparent change noticeable in the general configuration of the devices under inspection. Without entering deeply into the considerations involved, it might be known that the American Institute of Electrical Engineers has expressed its opinion, in the shape of a set of rules and ratings, which are intended to cover the requirements of machines in a more or less uniform manner. The report of the Committee on Standardization, in its review of the facts relating to alternating current generators, speaks specifically and emphatically of the limitations of load in section (92), with regard to direct as well as alternating current machinery. This 92nd section of the report is divided up into seven parts, each of which cover some particular point in the operation of machines, including alternators, transformers, synchronous converters, exciters and synchronous motors.

It might be well to state that testing, in connection with alternating current devices, would include such apparatus as generators, static and rotary convert-

ers and induction and synchronous motors. The general test that all types of machinery must meet, is that of the insulation and normal temperature under normal conditions. The idea involved in an expression of opinion relative to such tests is that the voltage of the machines must never be too much for their insulation, and the wasted power appearing as heat never too much for the bulk of material exposed to it. In other words, neither the insulation must be affected by continuous operation, nor the heat too great in any respect. A mechanical inspection of the parts is, of course, a foregone conclusion wherever such parts can be inspected. Journals that wear loose or heat are included in this scope, as well as other purely mechanical features discovered in any device with a rotating part. The idea, therefore, is that of making primary and secondary tests, if such an expression can be used without misunderstanding. The primary or most important tests relate to the most important features. The secondary or less important tests, relate to conditions that do not directly imperil the operation of the machine. One feature in constructive work that is not to be forgotten is the ever present possibility of insulation degenerating. It might be proven in a variety of cases that insulation has done so, and in consequence led to such damage that were the chain of circumstances followed up logically, considerable financial loss would be readily proven. A high potential testing device is necessarily the proper adjunct to a complete equipment. The voltage it is capable of generating should be such that insulation can be thoroughly tested and thus freed from any doubt that may exist regarding its integrity.

Interrupted Service.

Breaks in the continuity of a system, or lapses in the supply of electricity, are about the most expensive of all accidents, other than fire, to which attention can be drawn. Every hour of the day is an income to electricity producing concerns. And if, through accident, the system cannot deliver energy for a given period, for just that space of time the income ceases. The end of the income is the most fatal of all difficulties in a financial sense, particularly on account of the fact that whatever would be thus earned is irretrievably lost. This has been the experience not only of electric light and power concerns, but street railways as well. The estimate made of the cost of operation is figured out for the year by the month, week and day. The average income, to balance this expense and pay interest on the bonds, the stock and such repairs and depreciation as inevitably occur, is also figured out by the year, month, week and day. Any lapse in this is a great loss, if extending over a period of a certain number of hours. It might almost be predicted with certainty that failure would occur if the number of hours of inactivity are those particular hours during which money is made to square the bond account. In other words, every hour is vital, particularly in a large company whose expenses, unless under severe, not to say rigid, control would rapidly get beyond the bounds of reason. It is the inherent tendency in large enterprises, and all great aggregations of capital, to develop a negative or disbursive side. This, if not checked, is the influence inimical to continued success. It is this influence which must be detected at once by the ferret-eyed manager, for it is above all things the forerunner of absolute dissolution.

In this sense, interrupted service means interrupted income, and interrupted income means a break in the continuity of the financial stream. This in itself is a very serious matter, as its occurrence once in all likelihood means its occurrence again, and a few repetitions are apt to become evidences of poor management, resulting in a lack of confidence on the part of the public, which also spells disaster. Interrupted service in some installations occurs more frequently than it should, and in consequence whatever may be the financial paper of such an organization, it slowly becomes discredited and the standing of the company fails. The difficulty that presents itself, and the only reason perhaps why such things occur or can occur, is the poorness of the plant, or the bad handling it receives from employees. There are a great many elements to consider, some even when considered proving hard to control, yet in the main evidence clearly shows that a dominant policy of care, economy and readiness for repairs is the only road to even partial success. Central stations, power houses, transmission plants and small lighting equipments are not so much sources of electricity for commercial or private purposes as they are forms of investment intended to yield certain returns. The whole problem is thus better understood in this sense, as one which must be carefully attended to to reach an adequate solution. It clearly

invites consideration of the highest order, from the financier as well as the electrical engineer. For this reason the entrusting of a plant of importance to the hands of unthinking and indifferent employees amounts to a crime. Frequent lapses of service may be accounted for in this way, and as a consequence may end in permanent injury to the once hoped for success of the enterprise.

CURRENT IDEAS

For Furnishing More Light, Heat and Power from Central Stations.

Organization and Conduct of a New Business Department Suitable for Central Stations in Cities of 50,000 Population and Under.

By M. S. Seelman, Jr.

I have been recently in a number of cities, not alone of 50,000 and under, but of 100,000 and over, where the central station had not only no organization for securing new and retaining old business, but no sense or appreciation of the lack of it. These companies do no advertising, make no attempt to educate their public to a knowledge of the superior advantages of an electrical service, have no special propositions, employ no canvassers. Some of them do not even follow up the permits for new buildings. They give no suggestion to the customer as to the most economical and effective methods of lighting his home or store or factory—that is left to the wiring contractor, who in all likelihood has an exceedingly primitive and limited idea of illuminative engineering. The attitude of such a central station may be thus expressed: "Here we are. If you really want to buy current from us and are careful in arranging necessary preliminaries and formalities, we will agree to supply it to you." In one city of about 50,000 inhabitants, not one hundred miles from New York, the customer before being permitted to do business with the central station must come to the company's office and sign his (or her) name in a big book kept for that purpose.

The business that comes to these central stations drifts in. If the station makes money it is rather in spite of itself than because of itself. And, under the circumstances, sooner or later the municipal ownership propaganda is certain to take strong hold. There is need of stirring and enlightenment. These stations must "awake, gird up their loins and go forth to do battle" for business.

If I was to be asked what the company, awaking from its lethargy and desirous of securing the possible business within its sphere of operation should first do toward establishing an effective organization, I would say:

Hire a good man, if possible one familiar with the kind of work he will be called upon to do; a man under 40 if you can, better yet under 35. If you can secure one with a combination of technical and commercial knowledge, not necessarily an engineer, but a man who has been trained around a central station, knows something about generating and distributing methods and has tackled lighting and power problems before, so much the better. But above all, he must have "ginger," he must be a hustler with red blood in his veins and in his heart the zest for labor and the pride and loyalty of the service. If the time comes when expert or technical knowledge which he lacks is needed, you can buy that for him, but you cannot buy the energy, the dash and the vim if it is not there.

There are many such men to be had. Sometimes we find the very man in charge of some smaller central station. A good place to look for him also is among the employees of the larger companies, where the live young man is likely to have had a more comprehensive experience than would have been possible in a smaller station and still, because of peculiar conditions, to be working for a wage which would make an offer well within your limit, personally flattering and financially attractive.

This man shoud have charge of the organizing and conducting of our new department. Let us consider him as having been installed and call him the General Agent.

The first step our general agent shall take is to establish a first-class and highly attractive office and show room. This should be located on the main street or principal "square" of the town. If the

company's offices are already so located he can alter and utilize them—or a portion of them—for the purpose. But if, as is too often the case, the offices are on some side street at a distance from the business center, or even—as frequently happens—in the generating station itself, somewhere on the outskirts of the city, then the general agent must either get the company to move its entire offices, bag and baggage, to a main location, or else hire for his department alone, a suitable store. I should recommend the former course, so that every time a customer comes in to pay his bill or anybody enters the office for any purpose, he must necessarily see the exhibit of electrical appliances and utensils. Thus, the law of suggestion comes into play and the visitor becomes more or less interested in those things to which we desire to attract his attention.

This new office and show room must be made bright and attractive. The color scheme should be a creamy white that will reflect the light to the best advantage. The electrical exhibits ought to be as varied and complete as possible. A great many exhibits can be secured at little cost from manufacturers who will be glad to co-operate with the central station for the advantageous display of their wares.

The windows of this office must be utilized to illustrate different methods of show window lighting. Arranged on separate switches can be shown exhibits of trough incandescent lighting (as by Frinck reflectors), incandescents in combination with cone or holophane reflectors and Nernst lamps with the special Nernst reflectors. The common method of window lighting by means of projecting incandescents running around the sides of the windows, or by chandeliers, may also be shown, but in this case care must be taken to explain to customers that wherever the object of the lighting is to display the goods, then one of the three first-mentioned systems of reflected light from hidden sources is the more desirable, while the visible lamps, projecting or in chandeliers, may only be used to advantage when the object is not so much to draw attention to the goods as to attract the eye to the window itself, as with a saloon.

In the show window itself should be placed an exhibit of electric fans and heating appliances, such as irons, water and food heaters, coffee percolators, chafing dishes, stoves, toasters and grids, heating pads, curling irons and the like. Adjacent to each appliance place a neatly printed or painted card, naming the article and a definite price for its use, thus:—

THIS ELECTRIC IRON
CAN BE USED
ONE HOUR
FOR
SIX CENTS.

If there is room in the window, a sewing machine operated by a motor should be prominently featured and kept running, as a moving object attracts more attention than a still life exhibit. If you prefer, a buzz saw or a coffee-mill might be thus utiluized instead of the sewing machine. Two or three handsome reading lamps will add a touch of art and color to the window.

An exhibit of various types of lamps should be installed in the office. These should include arc lamps (one showing the concentric diffuser). one, two and three-glower Nernst lamps (there is a simple but highly artistic 5 single-glower Nernst lamp fixture which could well be made a part of this exhibit), meridian and high efficiency lamps. Cooper-Hewitt tubes, turn-down lamps—such as the Hylo—and attractive and efficient clusters, such as the arc, burst and the pagoda reflecting arc. Holophane glassware could be shown as an annex to this exhibit.

Two or three types of panel signs, individual letter signs and transparencies should be installed in this show room if there is space for them: novelties in signs and transparencies could be added from time to time.

The balance of the exhibit should be made as complete and interesting as is possible within a reasonable expense limit. There must be a motor exhibit of course and among other appliances that could be given a place in the show room might be mentioned these:—

Electric pump,
Electric organ blower,
Electric forge,
Electric drills and lathes,
Electric coffee mill,
Combination electric meat chopper and coffee mill,
Electric dough mixer,
Electric ice cream freezer,
Electric vibrators,
Electric dental machinery,

Prepayment meters,
Theater dimmers,
Electric vacuum carpet cleaner,
Motor operating refrigerating machine,
Motor operating adding machine,
The Gray Telautograph.

In a prominent place over the desks which his canvassers are to occupy, our general agent should have a sign hang, reading:—

DON'T TALK VOLTS AND AMPERES; TALK DOLLARS AND CENTS.

And this brings us to the subject of canvassers. The general agent will, of course, take steps at once toward securing the aides required in his campaign for new business, the principal questions that arise being: How many does he need; in what manner shall he secure them and how much ought he to pay them?

The solution of the first question must be governed to a considerable extent by local conditions—the industrial, commercial and residential nature and status of the town. Roughly speaking, I should say that—other things being equal—a city with 50,000 population or less, which is alive and fairly prosperous, would require one canvasser to about every 12,500 of population. This is an elastic rule, however, and must be freely interpreted. For instance, I have in mind a factory town in New England with a population of 100,000, of which 35,000 are mill hands, comparatively few of which would be "prospects." In deciding upon the number of canvassers needed there, that 35,000 would receive but scant consideration. Take it, then, that we start with one canvasser for every 12,500 population, and these we can lop off or add to as future conditions and contingencies may show to be necessary.

To secure the men we want, we must either again draft from the larger companies or advertise in technical publications. Very likely our general agent knows one or two men of the type he wants who are working for other companies and whose services he can secure. It may be possible to take an employee from some other department of the business and put him to canvassing, but my experience has been that such men are rarely effective and usually unsatisfactory. As a rule, if I had to, I would rather take salesmen from some other line of business and educate them.

As to remuneration, whether straight salary or salary and commission, is the best method of paying is a debatable question. I am a firm believer in the latter method as the one most effective for securing new business. Especially is this true in residence districts, where the householder must frequently be interviewed at night, the only time he is to be found at home. The canvasser on straight salary naturally hesitates to give up many of his evenings to this work, but if each call may mean a dollar or two to him, it becomes a different proposition. An equitable arrangement for the payment of canvassers would be, I should say, about $12 per week salary and a commission of two cents per 16 candle-power lamp equivalent for all over 250 equivalents a month the canvasser turns in. In addition the company should pay his carfares and incidentals.

Now, then, let us suppose we have gathered our selling force together and have equipped our show room. We are still not quite ready for business. It is advantageous, I believe, to give the new men the run of the office for a day or two, so that they may become acquainted with the company's physical layout and its installation, metering and service methods. During this time our general agent can have divided the city into districts, one for each of his canvassers. A word about this work of districting.

There are many cities where the business district is largely concentrated in the center of the town. In places of this kind I believe it an excellent plan—at least to start with—to district along lines starting at a common center in the business section and radiating outward.

In this way you give each man a portion of business section, of residence locality and probably of power territory. Later on you may find that one of your men is especially effective in residence work, another for business or for power propositions, and it is then easy to redistrict in accordance with the special qualifications of your men. Or, again, later on—to vary the system—occasionally one man may be given one line of business—the printers, or the butchers or bakers, or whatever line may be selected—to canvass right straight through, giving a report upon each one interviewed.

Now, then, we are nearly ready to canvass. Our general agent gives his men a selling talk—not only to inspire them with enthusiasm, but to give

them the last word of information as how to approach and handle various light and power propositions as they may present themselves, so that the men may be competent to advise prospective customers as to matters involved in their installation, such as wiring, selection of lamps and glassware, location of switches and outlets, painting and decorating of houses and stores to produce the best and most economical lighting effects, types of motors in general most suited for special classes of power work, ideas and methods of apportioning the units in a power installation, etc., etc. It is well if these instructions, together with the special propositions offered by the company, be gotten up compactly in small book or pamphlet form and handed to each canvasser. Of course the canvasser must be told to refer at once all propositions that he finds himself unable to adequately or competently handle to the general agent. If he starts such business he is entitled to his commission thereupon, even if the deal has to be consummated by the general agent or some expert or specialist. In connection with this talk of the general agent to his men, it may be said in passing that it is excellent business to secure from time to time and as frequently as possible experts in various lines to address the members of your business department—illuminating engineers, power men, Nernst, meridian and high efficiency representatives, heating appliance manufacturers and the like. This helps a great deal.

Now to canvass. Some might advise a preliminary canvass to secure names and addresses of prospects, but I believe in digging right in from the start, reaching out after business from the first day. The district agent begins work about 9 A. M. and is instructed to report back about 4.30 or 5 P. M. If this is not practicable on account of distances, then reports can be limited to the morning session, the district agent arriving at the office at 8 instead of 9, but where practicable it is better to have the agent return late in the afternoon so that he may report on his day's business then, giving time for the general agent to go over the reports and prepare his instructions to his men for issue in the morning.

There are a number of systems of keeping track and record of canvassers' work. The card system is probably the best for the city of 50,000 or less. The district agent's daily report of his work he makes out in the form of a card for every one visited, on which card is inscribed name, address, nature of business, date visited, attitude of the visitee, prospects of doing business with him, when to call again, etc., etc. This is not a particularly arduous job for the canvasser as he is not likely to call upon more than from twelve to twenty people a day.

The general agent must look these daily card reports over carefully before they are alphabetically filed away. He must especially note any difficulties or obstacles encountered by his men, and he himself must bend his best sales efforts on these specially difficult problems and propositions. If a canvasser reports a man as positively out of the prospective class, before the general agent accepts this classification, he should either send someone else to see the recalcitrant or go himself. In this way the impossible can be eliminated and the card catalog list becomes a list of prospectives.

And this list of "prospects" soon assumes proportions and furnishes the very best possible list for the effective distribution of printed matter.

And this brings us to the important subject of advertising.

I am inclined to believe that newspaper advertising is likely to be more advantageous and profitable in a small city than it is in a big one. There should be more or less of it done in every city, not only because it promotes a desirable feeling of good will between the newspapers and the corporations, but because it certainly has a very real educative value. In the average big city, however, the character of the population is such that out of a circulation of say 100,000 that some newspaper may have, only one or two thousand may be possible customers. In advertising, the company must pay to reach the 98,-000 unprofitable ones along with the 2,000 prospects and it is, as a general proposition, uneconomical to pay for all this surplus publicity. In the average small city conditions are different. Circulations are not so large nor mediums so numerous, advertising charges are not so heavy and a larger proportion of readers are likely to be prospects. So that, for advertising in the city of 50,000 or less, I would utilize the newspapers to a considerable extent. Take a whole page or a half page once in a while on some special occasion, such for instance, as a reduction in rates or the inauguration of some new policy or special proposition, or a marked addition to station capacity. At other times use an advertisement each week in dailies, not all the year round, but for certain months in the year, pausing now and then to take breath and gather renewed energy for a new

campaign. The size of these ads. should not be fixed hard and fast, but should vary up from a minimum of 5 inches single column or 4 inches double, according to the particular message it is desired tc convey.

I doubt if a central station in a city of 50,000 or less would support a first-class advertising man, and the other kind is of little use—liable to cost a good deal more than his salary. If your general agent can write a good ad.—and a good ad. does not need to be "smart" at all—it is merely the embodiment of a common-sense argument or a special proposition in an attractive form—so much the better. He can do that part of the work to advantage, especially if it is some special proposition or announcement of local interest and value that is being made. For general advertising of educative effect some of the advertising agencies that have made a specialty of electrical work—notably the Curtis Advertising Company of Detroit and the C. W. Lee Company of Newark—get up clever and attractive newspaper ads., both text and illustration, and supply them at a price that any central station office can afford. Or the general agent can secure samples of the advertisement of the larger companies by writing for them and many of these can be adapted for local use.

The same rule or methods may follow in securing advertising matter for the other, and, in my judgment, more valuable system of advertising by letters, circulars, booklets, etc., distributed through the mail. The advertising agencies get up some very excellent and relatively inexpensive general educative matter which is printed with your name and—as far as anyone who receives it knows—emanates originally from you. In this category is the "Residence Number" of the *Electrical Bulletin*, recently issued by the Curtis Company. Letters, circulars, etc., that refer to purely local offers; conditions and announcements must of course be gotten up in the home office by the general agent or an assistant, and here again samples of the big companies' advertisements will be of aid, if not to pattern after, at least to suggest ideas and methods of treatment. Another big help is to get a good printer, even if he costs you more. Don't have a poor printer if you can avoid it at any price. The good one is often able to aid you with ideas, suggestions and plans for the effective construction of advertising matter.

Here is a point that should be borne in mind: Never send out a piece of advertising matter without enclosing a return post card. A fundamental law of political economy is that man is a lazy animal and you want to make the path to your front door as easy and smooth as possible. Each different branch of the business should have its distinctive return post card, so if you send out a lighting circular you enclose a lighting post card; a sign circular, a sign post card, and the same with power, fans, heating and refrigeration, if you go that far. Don't make it postal card; that is expensive, but an attractively printed post card with your address and place for one cent stamp on one side and on the other a printed form referring to the matter in hand and space for the name and address of the sender. I have experimented as to the relative advertising value of the penny U. S. postal card and the plain post card for this return work, and find that while the cost is as 6 to 1, the latter is nearly as effective as the former. This return post card method gives you a fair chance to estimate the interest your advertising is arousing and leads, if the advertising is right and other things being equal, to a continuous and often surprisingly large amount of new business.

The system of doing the bulk of your advertising by mail distribution of circulars, booklets, etc., rather than through the newspapers is the best because you reach, if your campaign is rightly conducted, just the people you wish to reach and with the least waste of expensive publicity. Your list of prospects is a good list to work on, and that can be supplemented by special lists for special purposes, as for instance, a sign list composed of present store customers and stores not yet using the service, but whom you hope some day to secure. Your sign proposition may be the entering wedge.

And this brings us now to another very important feature of and factor in a new business campaign and that is the special propositions.

And right here I want to say that if you want to get a big share of new business, you have got to be liberal, you have got to go half way to meet the customer, you have got to be willing to spend a dollar to make two.

A good many companies are ready to make extensions, even in cases where it takes quite some time to get back the original investment, not to mention a profit, yet they turn away haughtily from the proposition to supply a customer with some equipment which in a far shorter period pays for itself and gives a handsome return on the money invested.

There's the free sign proposition, for instance; it has proven "good business" everywhere it has been tried, so far as I know. A panel sign costs you complete about $45; with overhead construction, customary in the city of 50,000 or less to hang and connect the sign ought not to cost more than $25. There's an investment of $70. Take 200 per cent. of your investment—$140—divide it in 24 parts and offer your customers free signs on a two years' guarantee of $6 a month. You are sure to get back the cost of the sign and installation well within the two years, even if the customer's current bills do not run above the guarantee (which is unlikely). As a matter of fact, you usually get back the actual cost, including the proportion of operating expense, within the first year and all the rest above percentage of operating work is velvet, especially as in fully 95 per cent. of cases, the customer keeps on using the sign far beyond the two years of his contract. Not only this, but each sign you thus erect is a good advertisement for you and helps bring another, besides being, as aforesaid, in many cases an opening wedge for other business with the customer, and you retain title to the sign; so that in case of the worst your loss must be small, as the sign with slight changes can usually be utilized for some other customer.

With individual letter signs the return of the investment with profit is even more rapid than with the panel sign because they use more current in proportion to their cost to you. When giving an expensive sign, however, care must be exercised as to the financial responsibility of the recipient.

Still another advantage of the electric sign proposition is that it leads the merchant to realize the advertising value of electric light, so that he not only burns his sign at night, but is likely to get in the habit of keeping his windows illuminated some hours after closing, and this again leads others to do the same. Such night lighting has a far-reaching effect in creating new business for the entire town, increasing the activity and energy of its life and materially assisting in its development.

The sign is a good advertisement to the customer too, and economical as well. Suppose it costs him $10 a month for lighting it. How much newspaper advertising could he buy for that amount. How many circulars can he print and distribute? Why, it would cost him that much to buy a thousand postal cards without the charge for printing and addressing them, while his sign, for $10, is brightly visible for three or four hours every night to everyone who passes the store, giving it a distinctive character and "burning his name into the public mind."

The town in which this free sign proposition will not "take," if it is properly advertised and pushed by the new business organization, must be dead indeed.

Then there are the special lamp propositions. There are doubtless many stores in the city in which we are hustling for new business, that are illuminated by the gas arcs or Welsbachs, which we find it impossible to touch with the ordinary standard incandescent lamp proposition. Here is where the Nernst lamp comes in, also the high efficiency and meridian lamps. Each has its place. The Nernst is an attractive proposition to a customer, especially a lamp about three-glower size. It is highly attractive, even decorative in appearance, gives a beautiful pearly white light and is in every way far superior to any gas lamp, being at the same time so efficient in wattage as to permit of free competition with gas. And from the station's standpoint it is not nearly so expensive of maintenance as—from some reports—we might be led to believe. If our friends who are out after new business will supply these lamps free with free glower renewals, even with free wiring and installation for outside lamps, they will find this proposition a potent factor in securing new and profitable customers and the stores where you install the lamps outside will most likely soon install them inside at their own expense. The meridian and high efficiency lamps can also be worked in the same way, either in direct current districts or on overhead circuits, where the customer, having his choice, may select one of these types as preferable. The new decorative and highly efficient "arc" clusters that have recently been placed upon the market may be utilized to advantage where the customer is disposed to complain of the arc lamp, at arc lamp cost of operation. They give adequate illumination of fine quality at a very low cost. With these, as with signs and other lamps, don't be afraid to go half way to meet your customer.

A method of getting one class of new business which has worked well in at least one large city, but which might or might not be applicable to the city of 50,000 or less, can be utilized with the drug stores.

Here hours of burning are long and the average drug store may not be able to afford the average rate for the average installation. Still you

cannot cut rates for him and be consistent. Get up an attractive advertising bulletin stand of wood and iron that will cost you about $15, with a frame in the top portion for a placard and beneath this pockets for bulletins and other advertising matter. Then make an arrangement with the druggist now using gas that in consideration of his permitting you to keep your advertising stand in a prominent place in his store you will pay him a sum, which subtracted from the bills at regular rates for lighting his store by electricity, will make such illumination economical for him. The placards, bulletins, circulars, etc., are changed once a month. It is good advertising for the central station too, because as a rule the right kind of people deal in drug stores, and while awaiting the compounding of prescriptions have time to read your advertising, which is placed where they cannot help but see it.

One way to get at a gas illuminated store is to offer to draw, gratis, plans for the electric illumination of the store which will provide a lighting far superior to gas, adding materially to the attractiveness of the establishment at a price little, if any, heavier than the storekeeper has been paying for an inferior illuminant. This can be done by selecting the right kind of lamps and glassware and arranging them to advantage. One of your canvassers could easily be educated to do this class of work. Once the plans are drawn, the storekeeper is very apt to become sufficiently interested to wire up and sign a contract.

Now as to residences and new buildings. In the average town of 50,000 there will be found about six architects, in the town of 25,000, three. One of the first acts our new general agent must do is to set himself to get acquainted with these architects, not alone in a business way but, if possible, socially, so that a feeling of friendliness may spring up between them. Let him join their clubs, take them out to dinner, etc. After the "entente cordiale" has been established, our general agent is in a position to know from the start what is taking place in the line of erecting new structures and he is less likely to be called upon to continually fight the installation of isolated plants. Get the architects on your side.

Then, of course, the buiding permits must be followed up closely. Let no guilty man escape. Every new building must be wired and the way to do this is to see the builder the day his permit is issued (before, if possible), and to follow him right up until the business is done. The same with permits for alterations. When the owner is about to make alterations in his home or store, that is the psychological moment to approach him about installing an electric illumination on the premises. These are new business pointers that cannot be neglected.

A far stiffer proposition than the new residence is the unwired old one, and yet there are doubtless hundreds of these—even in a city of 50,000—which if wired would yield a fair and certain revenue. How to get them wired is the problem. Your advertising helps by bringing the householder to a realization of the many advantages and conveniences of an electric service. Then it is a good plan for your canvasser to call in the day time, get the "lady of the house" on his side and then make an appointment for evening after supper, when the householder is likely to be in the right frame of mind and the canvasser can meet wife (already predisposed in his favor), and husband together. May and June are especially good months to canvass residences, because families who are out of town in July and August can arrange to have the wiring done in their absence, saving them some inconvenience.

But there are householders who would like to have an electric illumination who do not feel that they can afford to pay out the cost of wiring in a lump sum. If these be reputable citizens let the company help them out by financing the deal, the money to be repaid within a year in monthly instalments. If this wiring would cost $200 to $250, and that is more than the householder wants to spend, suggest to him that he wire his living rooms—dining-room, kitchen, cellar, back parlor, parlor and lower halls, which can be done within $100, including fixtures.

The above refers to cases where the tenant is also the owner. Where he is not the owner the difficulties multiply. Here is a plan or scheme that might prove efficacious under the latter circumstance and is worth while trying where neither landlord nor tenant is willing to pay the complete cost of wiring. Approach the tenant and tell him that you can appreciate the fact that he is unwilling to spend from $100 to $250 in improving somebody else's property, but that it certainly is worth something to him and his family to enjoy the comforts, conveniences and elegancies of an electric service. Then make this proposition to him: If he will see his landlord and get the landlord to pay one-third the cost of wiring,

and he (the tenant), will pay another third, the company will pay the remaining third of the bill. This ought to be an attractive and paying proposition for landlord, tenant and company.

You can secure residence lighting, also, planning on paper an appropriate illumination for some particular home, and interesting the resident in these plans. It is a case of being alive and hustling.

In pushing electric heating and cooking devices some companies have acted in co-operation with the department stores. From personal experience, I should say it is better for us to go it alone and let the department store do the same. Our standpoints and purposes are widely different. The store sells the appliance for the profit in the sale and the profit must be a large one, for sales are necessarily limited in number. The central station's object is not to make a profit on the sale, but to get the appliance on the system where it will use current. For a G. E. six pound iron, for instance, the store charges $4.00; the iron cost the central station about $2.85, and the latter is glad to sell it for $3.00 if an arrangement with the store does not tie its hands; and you can sell four irons at $3.00 to one iron at $4.00.

The method which has been most successful in placing irons is to send them out on trial, putting one in every house equipped for an electric service. In the city of 50,000 or less, I would advise either using one of your canvassers for this purpose throughout the city, or else making each canvasser take care of his own district in this respect. Load the irons in an auto and when leaving each iron for a trial of from thirty days to three months, have the canvasser give a little selling talk and leave a neat circular calling attention to its many advantages. Also, let him leave a postal card addressed to the company, explaining that it is possible, though not probable, in first using the iron that some trifling trouble may be experienced, in which case tell the customer not to condemn the iron but to send the postal card, when the company's representative will call and straighten out the kinks. The iron is all right, and if followed up in this way is bound to prove a boon to the housewife and a source of revenue to the company.

As a matter of fact, these irons could be given away with profit by the central station. They cost, say $3.00, and bring in a revenue, which begins the minute they are placed on the system, of about $1.00 a month. In three months the first outlay is returned, in six months the iron is completly paid for out of the profits, and becomes from that time a constant agent of profitable income. And it is day load, too. In those cities where you may fail in securing the $3.00 for the irons—give them away.

Other heating and cooking devices are not so valuable to the central station as the iron, but they all have their place in popularizing current. You have your display of them in your show room. Get up a "demonstration." Hire an attractive young lady to do the cooking and send out invitations to your customers. Give them something dainty to eat and a small souvenir of the occasion. Have your advertising and your men follow this up and you will sell a sufficient number of appliances to make it pay.

The use of electric fans can be increased by judicious advertising and canvassing; and if you are not afraid of complications with contractors and supply dealers, by selling them at a low figure—a price approximately cost. If you have considerable surplus supply, rent them out for the summer months.

I will not touch on the increase of business from the city itself for lighting of streets and public buildings. This matter is usually taken care of by some official of the company and does not customarily come within the province of our new business department.

I have purposely kept the subject of increasing the power business to the last, because it is at once, being primarily day load, of the utmost importance to the central station, and at the same time ordinarily the most difficult to secure.

First of all, let me say that while it is possible to secure lighting business at a higher price than is paid for other illuminants, because of superiority and also because average installations are of such size that isolated generating plants are impracticable, to get any large slice of new power business, your price has got to be right, for even if you can go into a factory and demonstrate how by cutting out friction load you can largely reduce the energy required to turn the wheels, if your rate for current is too high there is nothing to prevent the mill owner from taking advantage of your trip, eliminating much belting and shafts, installing motors and putting in his own dynamo.

Power business is such good business that special effort to get it is well worth while. If within the limits of possibility make your rate right to begin with.

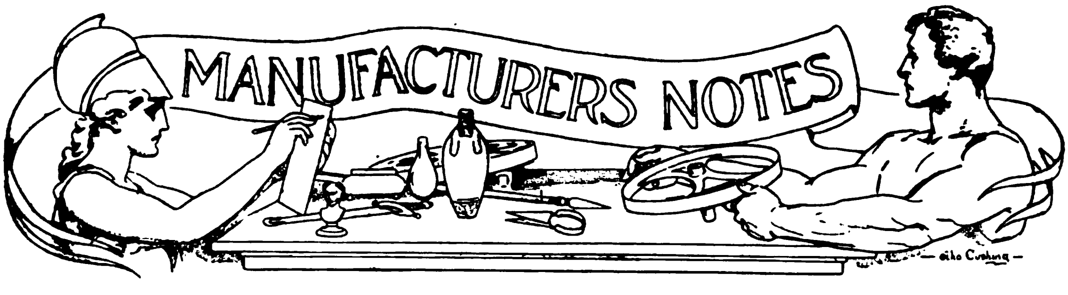
It is more difficult to secure a good power canvasser than the other kind. If your general agent is enough of a technician and sufficiently familiar with power problems to handle this end of the business, that is a tremendous help. If not, and there is much power business in your town, then in addition to your other canvassers, you will have to hire a power expert.

The way to get power business is to get it. There must be energy, enterprise and indomitable tenacity on the part of your power man, backed up, on the part of the company, by a readiness to help and a willingness to be liberal. I know a general agent, who is also a power man in a manufacturing city of 25,000 inhabitants, who has got a big load of new power business for his company by use of the qualities I have mentioned. He goes into a factory, indicates, at the company's expense, the engines in use, figures out the energy saving he can effect by the use of motors, installed to the best advantage, finds out what its coal and water costs the factory, and has been enabled more than once to go in and win on a guarantee not to exceed for expense of operation, these coal and water charges, getting eventually from four to six cents for the current. If the factory owners balk at the expense of motors, he offers to buy them and receive payment in installments. If installation is going to interfere with the needed operation of machinery, he agrees to install the motors at night, on Sundays and holidays. That man has got ginger, and he does the business.

There is one matter that your general agent and canvassers must not lose sight of. In the natural desire for new business, do not overlook or neglect old business.

As soon as the canvasser has signed up a customer the tendency is to quit him and pass by on the other side of the street. This must be avoided. The customer ought to be frequently visited by the man who took his contract, cementing an acquaintance, ascertaining and attending to his wants, and what is of the utmost importance in more ways than one, retaining his good will. If the customer has a complaint, it is better to relieve him of it than to let it rankle in his chest, and the complaint may be of something readily remedied. Besides, the customer may desire to add to his installation. Actually the old customers ought to constitute one of the most fruitful fields for new business. Don't neglect them.

In line with this care of old customers, here is one idea which can be followed to advantage. The bills each month should be compared, either in the metering or billing department, with the bills of the month previous. Whenever any marked drop is noticed the case should be called to the attention of the general agent. In nine such cases out of ten something is wrong which, taken at once, may be remedied with little loss to the company. If, on the other hand, the matter escapes notice, the customer also may escape, and at any rate the revenue from him for many months is likely to be greatly reduced or lost altogether.



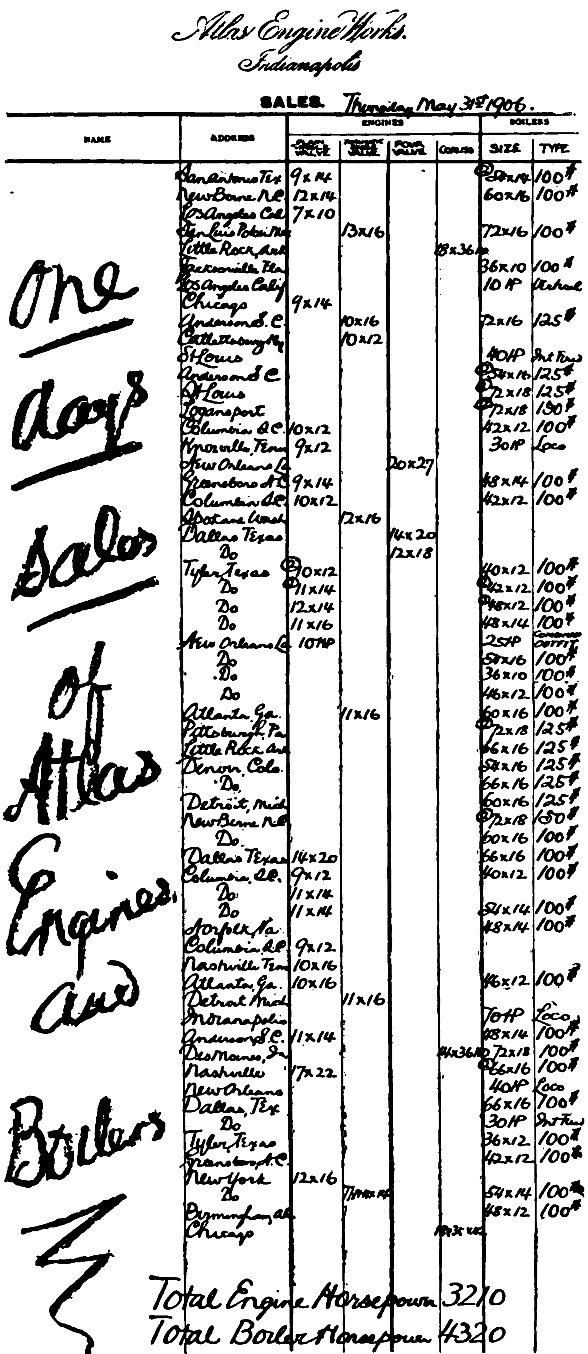
An Allis-Chalmers Turbo-Generator for Wilmington.

The Interstate Railways Company, of Philadelphia, Pa., has recently concluded the purchase of new power equipment for the Wilmington & Edgemoore Electric Railway Company, Wilmington, Del., consisting of a 500 K.W. Allis-Chalmers Steam Turbine and Alternator, and a 40 K.W. Allis-Chalmers Generator for direct connection to a 10 x 10 Ideal Engiene. The Turbo-Generator unit is a 2,300 volt, 2 phase, 60 cycle machine, operating at a steam pressure of 140 lbs., and producing its rated output at 100% power factor with a 40 degree rise in temperature of the generator.

Units similar to this one are now on order for

the Meriden Electric Light Company, of Meriden, Conn.; Canton Light, Heat & Power Co., Canton, Ohio; Western Gas & Electric Company, of Aurora, Ill., and the City of Jacksonville, Jacksonville, Fla.

A new and rather novel idea in the world of publicity has been presented by the Atlas Engine



Atlas Engine Works.
Indianapolis

One days Sales of Atlas Engines and Boilers

SALES. Thursday May 31st 1906.

NAME	ADDRESS	ENGINES: PLAIN VALVE	ENGINES: [illegible]	ENGINES: FOUR VALVE	ENGINES: CORLISS	BOILERS: SIZE	BOILERS: TYPE
	San Antonio Tex	9x14				(2) 54x14	100#
	New Berne N.C.	12x14				60x16	100#
	Los Angeles Cal	7x10					
	San Luis Potosi Mex		13x16			72x16	100#
	Little Rock Ark				18x36		
	Jacksonville Fla					36x10	100#
	Los Angeles Calif					10 HP	Vertical
	Chicago	9x14					
	Anderson S.C.		10x16			72x16	125#
	Catlettsburg Ky		10x12				
	St Louis					40 HP	Int Fire
	Anderson S.C.					(2) 54x16	125#
	St Louis					(2) 72x18	125#
	Logansport					(2) 72x18	150#
	Columbia S.C.	10x12				42x12	100#
	Knoxville Tenn	9x12				30 HP	Loco
	New Orleans La			20x27			
	Greensboro N.C.	9x14				48x14	100#
	Columbia S.C.	10x12				42x12	100#
	Spokane Wash		12x16				
	Dallas Texas			14x20			
	Do			12x18			
	Tyler Texas	(2) 10x12				40x12	100#
	Do	(2) 11x14				(2) 42x12	100#
	Do	12x14				(2) 48x12	100#
	Do	11x16				48x14	100#
	New Orleans La	10 HP				25 HP	Complete outfit
	Do					54x16	100#
	Do					36x10	100#
	Do					46x12	100#
	Atlanta Ga.		11x16			60x16	100#
	Pittsburgh Pa					(2) 72x18	125#
	Little Rock Ark					66x16	125#
	Denver Colo.					54x16	125#
	Do					66x16	125#
	Detroit, Mich					60x16	125#
	New Berne N.C.					(2) 72x18	150#
	Do					60x16	100#
	Dallas Texas	14x20				66x16	100#
	Columbia S.C.	9x12				40x12	100#
	Do	11x14					
	Do	11x14				54x14	100#
	Norfolk Va					48x14	100#
	Columbia S.C.	9x12					
	Nashville Tenn	10x16					
	Atlanta Ga.	10x16				46x12	100#
	Detroit Mich		11x16				
	Indianapolis					70 HP	Loco
	Anderson S.C.	11x14				48x14	100#
	Des Moines, Ia				14x36	72x18	100#
	Nashville	17x22				(2) 66x16	100#
	New Orleans					40 HP	Loco
	Dallas, Tex					66x16	100#
	Do					30 HP	Int Fire
	Tyler Texas					36x12	100#
	Greensboro N.C.					42x12	100#
	New York	12x16				54x14	100#
	Do			[illegible]		48x12	100#
	Birmingham, Ala						
	Chicago				[illegible]		

Total Engine Horsepower 3210
Total Boiler Horsepower 4320

Works, of Indianapolis, in the publishing of their sales sheet for one day—May 31, 1906—a fac-simile of which is reproduced herewith. It is indeed an interesting piece of reading matter, showing well the field covered by this concern, as well as the immense range of sizes and styles of steam engines and boilers which they manufacture.

Appearing on it is the sale of thirty-eight steam engines and fifty-seven boilers, representing in all over 7,500 horsepower, which, it is claimed by the Atlas people, is the largest single day's sales of steam engines and boilers ever made by any steam engine and boiler manufacturer in the world. It is estimated that the aggregate amount of these sales will run close to fifty thousand dollars.

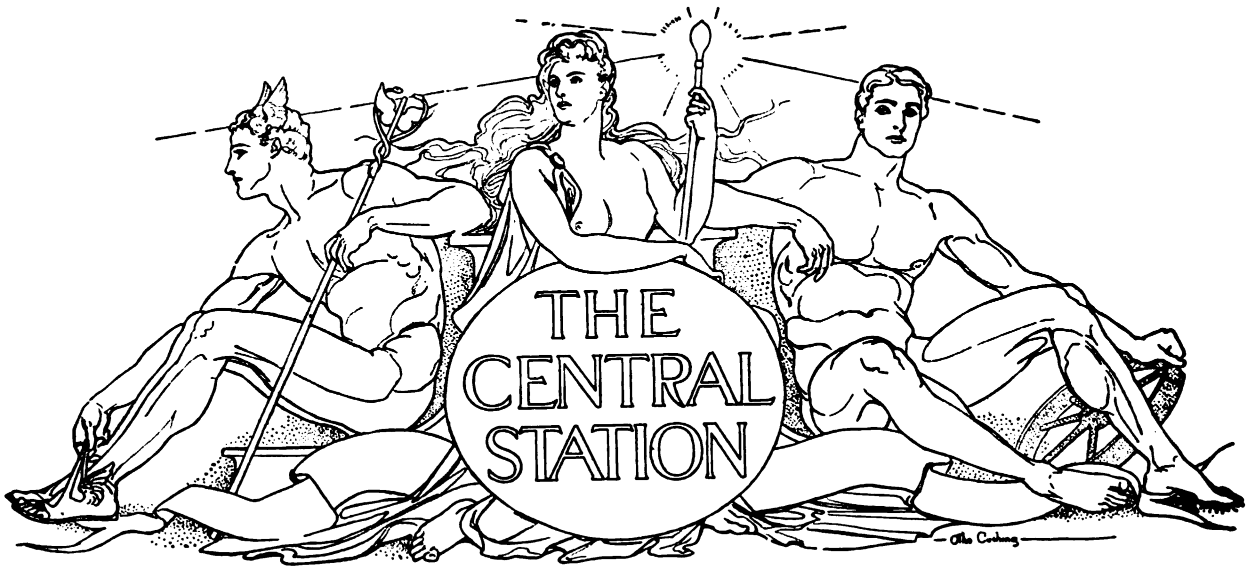
The Stanley-G. I. Electric Mfg. Company, of Pittsfield, Mass., have just placed on the market a new and novel type of induction motor made in various sizes up to 7½ h. p.

The novel feature of this motor is in having the laminated iron core of the stator freely exposed to the air around its entire periphery.

Because of the fact that the frame is held together by means of a rivited construction, the motor will be known as the rivited frame type. The cast iron ribs which are used with the ordinary induction motors are entirely done away with and thereby all metal is used to much higher efficiency than ever before attained in induction motor design.

The De La Vergne Machine Co., Ft. E. 138th St., New York City, who are the sole licensees for the manufacture of the Koerting gas engine and producer in the United States, have just issued a ten page folder describing the Koerting four cycle gas engine and suction producer. These engines have met with remarkable success in Europe, where a large number have been installed in municipal lighting plants, factories and other places.

The Cutter Co., of Philadelphia, the largest exclusive circuit breaker manufacturers in the world, have just issued a new 196 page catalog illustrating and describing their complete line of circuit breakers for all classes of service. This new catalog is most conveniently tabulated and any and all information regarding their complete line of circuit breakers may be ascertained in a moment's time. Not only are the circuit breakers illustrated and described, but all dimensions are given in diagram, as well as the code words and prices. It is a reference book that every central station manager should have.



DEVOTED EXCLUSIVELY TO THE INTERESTS OF ELECTRIC LIGHTING AND POWER STATIONS.

VOL. 6, No. 3 NEW YORK, SEPTEMBER, 1906 ISSUED MONTHLY.

Central Station Light, Heat and Power Principles.

BY NEWTON HARRISON.

Phases of Current. The general idea embodied in the word phase is one readily grasped with respect to single, two and three phase machines. From a technical standpoint, phase really means electromotive force, but the word current is so frequently used in its place, that the expression instead of being single, two or three phases of electromotive force, is single, two or three phase currents. The term phase, in the case of a single phase current, simply means a single electromotive force and a single current which naturally follows after it. The degree of lag between the electromotive force and current, is due to certain inductive influences which in ordinary working circuits as well as the generators, is practically ineradicable. But when the case is considered of a machine producing what is called a two or a three phase current, in the light of these remarks, the conclusion must be obvious that such exhibitions of electrical energy consist primarily of two or three distinct electromotive forces (Fig. 1), with their currents more or less closely related through lag. Such being the case, it is not difficult to reason out the construction at least in principle, which must follow as far as the armature windings are concerned, and their relationship to the magnetic poles, whose lines of force create the single, two or three phases of electromotive force called phases. On this basis, it must be readily perceived, that respectively each winding must be distinct, so as to compose, in the case of a two phase, the equivalent of two windings, or in the case of a three phase, the equivalent of three windings.

A Two Phase Current. A two phase current, is one as defined, in which two distinct electromotive forces are in operation, a certain interval of time behind one another, with their respective currents following a greater or less interval behind each, according to the degree of lag. But it must be also evident that the position of the two electromotive forces behind one another, is governed entirely by the position of each set of conductors (Fig. 2), with respect to the pole pieces. In other words, the idea of a two phase current is not simply to produce two electromotive forces, arbitrarily separated from each other, to a greater or a less extent, but to produce two electromotive forces always separated from each other a definitely fixed amount. Mathematically, this degree of distance or interval of separation is

measured as an angle in degrees. As a matter of fact, it can be estimated and measured in time as an interval or period.

The suggestion adopted broadcast, that a single north pole represents 180 degrees, as far as the electromotive force it generates is concerned, may well be remembered as the basis of all calculations in this respect. In other words, if the electromotive force created in a conductor passing before it, is consid-

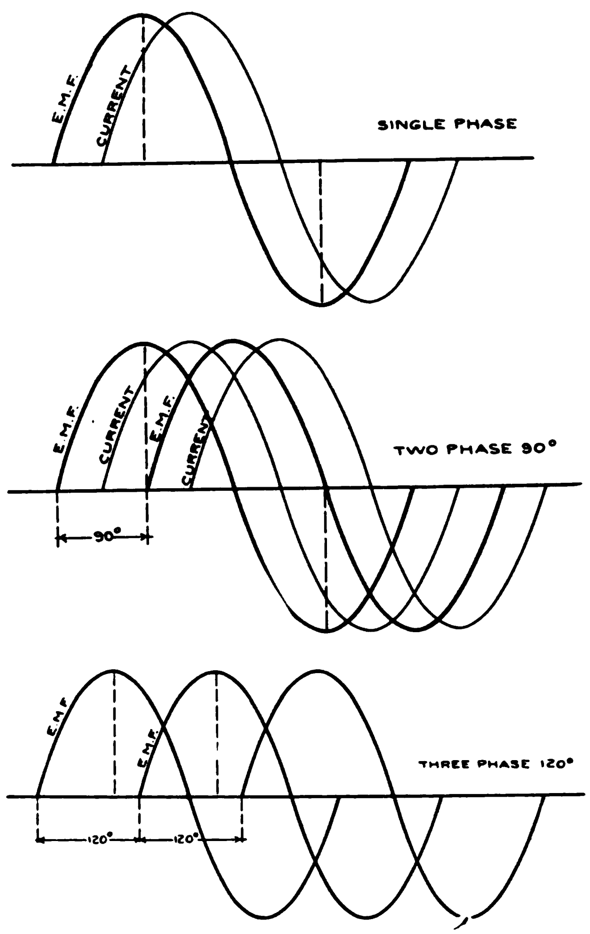


FIG. 1.—SINGLE, TWO AND THREE PHASE CURRENTS.

ered as representing 180 degrees from its inception, to its maximum value and back to zero, as shown by the sine wave, then it is simply necessary to know that a two-phase current means one whose electromotive forces begin 90 degrees behind each other. Or, to put it still more plainly, when one electromotive force has reached its maximum value, that is to say, its full strength, the second electromotive force has just begun to grow.

Two Generators and Two Phases. Were two generators of the alternating current type placed side by side, so that their armatures were on one

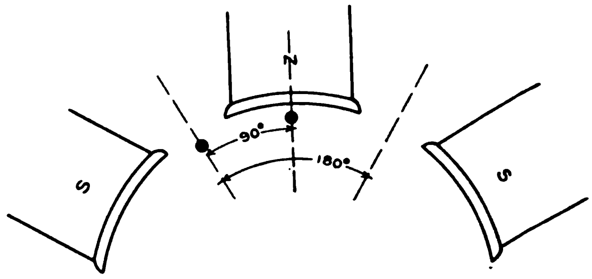


FIG. 2.—SEPARATION BETWEEN CONDUCTORS DEVELOPING TWO-PHASE CURRENTS.

shaft, then it is evident that the corresponding conductors on each would have to be "staggered" as the phrase goes, with respect to each other. The amount of this lack of correspondence of position of the

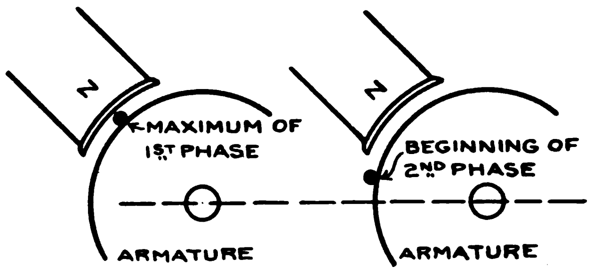


FIG. 3.—RELATIVE POSITIONS OF CONDUCTORS PRODUCING CURRENTS 90° APART IN PHASE.

conductors, would be simply equal to a little more than half the width of a pole piece in the case of a two phase current, or as in this case, of two currents 90 degrees apart in phase. In other words, two dis-

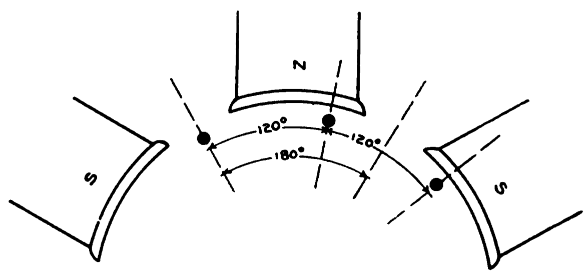


FIG. 4.—GENERATION OF THREE ELECTROMOTIVE FORCES 120° APART.

tinct generators with two distinct armatures (Fig 3), each operating in their respective fields, complying with the conditions as specified, would pro-

duce a two-phase current, as understood, both in theory and practice. The two electromotive forces would be 90 degrees apart, or an interval of time apart from each other equal to that which a conductor takes in moving from the space between any two poles to half way across the pole.

Two generators in this manner produce two distinct currents, always a fixed angle or interval apart. Reference is not made particularly in practice to the degree of separation between two electromotive forces of this character. This is always understood as being the angular difference between them. Though it is easy to realize that a two-phase current need not be characterized by only 90 degrees difference, the difference could be more or it could be less, but in such a case, its serviceability would be greatly affected. It thus becomes evident that a practical two phase current consists of two distinct electromotive forces always 90 degrees apart, and preserved purposely at this distance for reasons of a commercial and vital nature.

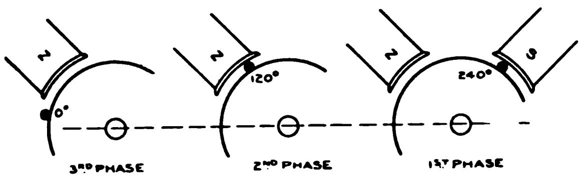


FIG. 5.—RELATIVE POSITIONS OF CONDUCTORS PRODUCING CURRENTS 120° APART IN PHASE.

The Three Phase Current. The three phase current could be more aptly called the three phase electromotive force. Instead of two electromotive forces a certain angle or interval behind one another, there are in this case three electromotive forces a certain angle or interval behind each other. These three electromotive forces have following, or nearly coincident with each, a current a certain angle or lag behind. Confusion is not necessary between what is called angle of lag and angle of phase. Angle of lag refers directly to the lag of the current or amperes behind the electromotive force which calls it into existence; whereas angle of phase refers entirely to that particular angle or interval between one electromotive force and another related to it and following it. The possibility of three electromotive forces being arbitrarily placed with respect to one another would constitute a three phase current. But though the angle between the first electromotive force and the second might be 60, 80 or 100 degrees, or in fact any number of degrees, and the same be true of the angle between the second and the third electromotive forces, the fact remains that what is called a three phase current, consists of three electromotive forces with each electromotive force (Fig. 4), beginning 120 degrees behind the one following or succeeding it. With re-

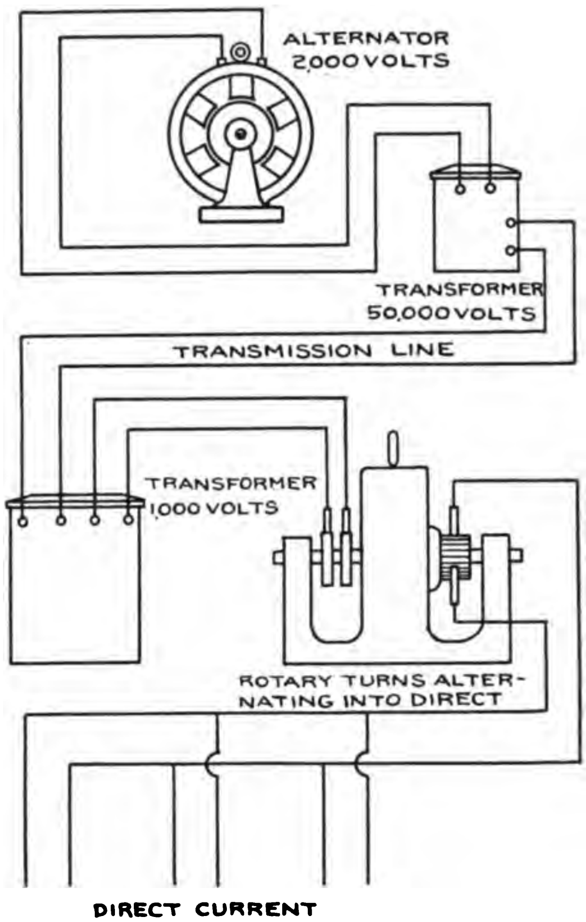


FIG. 6.—PROCESSES INVOLVED IN POWER TRANSMISSION AT HIGH PRESSURE ALTERNATING.

spect to the neutral space on each side of a pole, it is evident that the first electromotive force will be 120 degrees beyond its point of origination when the second electromotive force begins. The third electromotive force will begin 120 degrees behind the point of origination of the second electromotive force to complete the trio of pressures and complete the 360 degrees.

Three Generators and Three Phases. Three generators of alternating currents, placed side by side, with a common shaft, but three distinct armatures

and their individual windings, would form a basis for the production of currents, similar to those generally typified by the name of three phase currents.

The first generator would produce a current or to speak more correctly, an electromotive force, followed by an electromotive force from the second generator, and this in its turn by a electromotive force from the third generator. The position of corresponding conductors on the three armatures with respect to the same pole would be such, that if the beginnings of each electromotive force be considered it will be readily noted that 120 degrees of difference (Fig. 5), exists between each. In other words, the first conductor will be two-thirds across the angle subtended by the neutral spaces of two poles, or 240 degrees, before the third conductor begins its third phase of electromotive force at what would be called zero. The three generators, as thus related, would represent three distinct sources of current. Each of the three electromotive forces, would be followed by its respective current, a certain angle of lag of a greater or less extent separating them. But there being three electromotive forces there would be three currents and three angles of lag presumably equal to each other. Thus, the situation presented is that of three electromotive forces separated from each other by 120 degrees, and three currents closely following up or identical with the electromotive forces creating them depending upon their respective angles of lag. The angle of phase and lag are thus seen to be indications of entirely different conditions in the theory and practice of alternating current machinery.

Purpose of Two and Three Phase Currents. An outline of the difference between single, two and three phase currents, would not be complete without the reasons being given for their individual existence. The whole question hinges upon the possibilities involved in the alternating current motor, its ability to start from rest and its efficiency when in operation. The inventor of the two and three phase motor, meant the manufacture of a self-starting and efficient machine, entirely suited to power transmission and central station purposes. In addition, an economy in copper, is found in the transmission of this form of electrical energy which represents a considerable item during the installation of a power line. The fact that power is transmitted at very high pressures, does not mean that it is thus generated. In fact, it is generated at a much lower pressure (Fig. 6), than that at which it is transmitted. It is sent into transformers after being generated, and then raised up in pressure to the value suited to economical transmission through the line. The process from this point, the terminus of the line, is to lower the pressure to a value which permits its use in a so-called "rotary," in contradistinction to a static or stationary transformer. The rotary is practically a two or three phase motor with windings and a commutator at one end to produce a direct current. In other words, a two or three phase current can, by means of a rotary, be readily transformed into its full equivalent of electrical energy as a direct instead of an alternating current. In central station distribution, this is one of its characteristic features and most economical processes.

III. Modern Central Stations.

Belgian Horizontal Steam Engine Plants.

By Frank C. Perkins.

On the continent of Europe the direct-connected horizontal steam engine of the tandem compound and twin tandem triple expansion types have been favorites for a number of years. This has been true not only in Belgium and France but also in Germany. Some European engineers have lately taken strongly to the vertical marine types of engines as taking less space in central stations and also are employing steam turbines to a considerable extent. Other continental engineers still hold that the horizontal engine while taking more room is better cared for by the attendants than those types requiring the oilers to continually climb iron steps to the working parts of the engines.

In this article two Belgian plants are described using horizontal tandem compound engines at Ant-

werp and St. Gilles. The next article will describe, "The D'Ivry Station similarly equipped for supplying current to the Chemin De Fer D'Orleans for the Electric Traction at Paris and Juvisy, while the German central stations at München and Colmar I/E will illustrate the horizontal engine practice in that country and the central stations at Hamburg and Hof in Bayern will show the vertical marine compound types as favored by many German engineers.

The accompanying illustrations Figs. 1 to 5 show the interior and details of construction of the Belgian power station at Antwerp, a city of about 285,000 inhabitants. The engines, generators and switchboard equipment were installed for supplying current to the electric railway of that city by the Compagnie Generale des Tramways d'Anvers. The usual combination direct current and alternating current system now so commonly used for traction work in the United States as well as in Europe was adopted. The current is transformed at substations suitably located in the city for transforming the alternating current to a direct current of 500 volts for use on the railway feeders and trolley wires. The current is generated at the central station in the suburbs of the city and transmitted at high frequency to the sub-stations above mentioned. The power-house is provided with electrically operated conveying apparatus for carrying the coal to the boilers, the power station being located at the Merxem dock being very convenient for coal supply, a storage capacity of a million pounds being available.

The boiler house is about 50 meters long and 16.5 meters wide, equipped with a half dozen boilers of the Galloway-Cornwall construction, space being provided for four additional boilers when found necessary. The boilers have two fireboxes, a heating surface of 70 square meters, the steam being raised to a temperature of 350° F., by means of a superheater having 40 square meters heating surface, a Green economizer also being employed having 382 tubes arranged in two sets. There are two electrically operated pumps together with a Worthington pump, each of which has a capacity of 10,000 liters per hour.

The engine room noted in the accompanying illustration, Fig. 1, is 20 meters wide and 50 meters long and is equipped with 3 tandem compound Sulzer engines of 1,000 h.p. each, directly coupled to a 700 kw. a.c. generator of the revolving field type, constructed by the Societe Electrique et Hydraulique of Charleroi, Belgium. The engines have a maximum capacity of 1,650 h.p., the high pressure cylinder having a diameter of 675 mms., and the low pressure cylinder 1,100 mms., the stroke measuring 1,150 mms. in length. These engines were constructed at Gand, Belgium by the Societe Anontme Carels Freres. The engines operate at a speed of 92 r.p.m. and when developing 1,055 h.p. in a recent test at a steam consumption of 4.655 kgs. per h.p. hour, the temperature being 294°. The engine room is provided with an overhead traveling crane

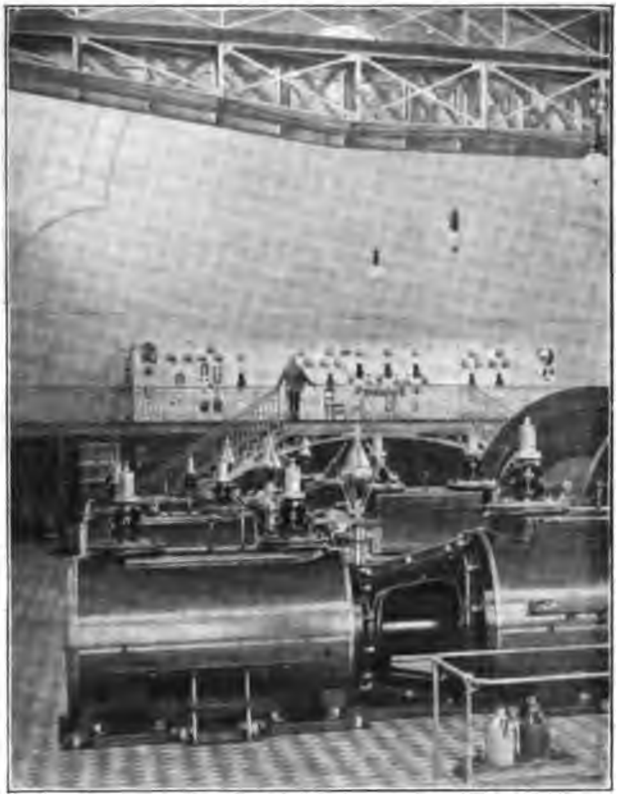


FIG. 1.—MAIN SWITCHBOARD IN ANTWERP STATION, BELGIUM.

having a capacity of 20 tons, for handling the heavy parts of the engines and alternators. The three-phase alternators, each having an output of about 1,000 h.p., supply a current of a frequency of 25 periods per second and a pressure of 6,300 volts. These alternators are of the 32-pole revolving field type. An additional flywheel effect being provided by a separate wheel weighing 11.5 tons. A motor generator is utilized for necessary exciting current for the alternators, in connection with an accumulator set of 60 Tudor storage batteries, having a

capacity at a three-hour discharge rate of 360 ampere hours. A steam engine and generator have also been provided for supplying exciting current, the direct-current generator supplying continuous current at a pressure of 120 volts. The motor generator set supplies the same current at the same pressure and is driven at a speed of 485 r.p.m. by

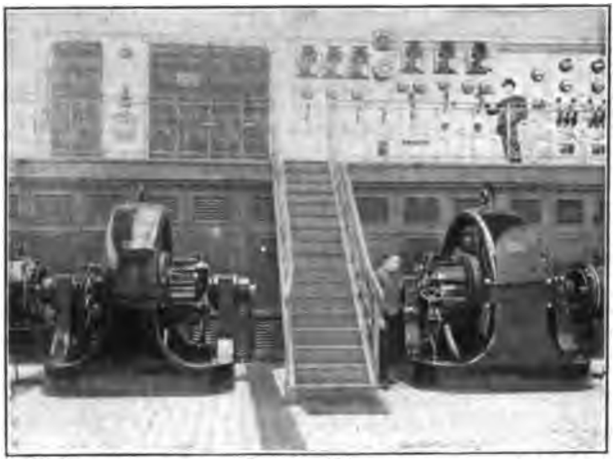


FIG. 2.—INTERIOR OF SUB-STATION, ANTWERP, BELGIUM.

an induction motor of 112 h.p. capacity supplied with three-phase current directly from the alternator at a pressure of 6,300 volts.

One of the sub-stations is located at Avenue du Commerce and has two rotary converters of the Westinghouse type, each having a capacity of 550 kws. These machines are supplied with three-phase current at 340 volts by stationary step-down transformers, receiving current from the high tension line at 6,000 volts. The sub-station is also supplied with a booster set and a storage battery of 1,360 ampere hours. There is another sub-station located at Rue Baudewyns, a distance of 7 kms. from the power house. There are also rotary converters in this sub-station of the six-pole type, supplying 1,000 amperes at 550 volts. These machines also have a capacity of 550 kws. and operate at a speed of 500 r.p.m. the current being supplied to these rotaries at 340 volts from step-down transformers similar to those mentioned above in the sub-station at Avenue du Commerce. The storage battery plant in this sub-station has a capacity when discharged in 3 hours of 800 ampere hours, this accumulator installation being utilized for regulation maintaining the voltage on the feeders practically constant. The city of Antwerp has nearly 200 cars in operation on a large number of streets of that city operating on double track construction to the extent of over 50 kms.

As shown in the accompanying illustration, Fig. 1, the switchboard is located at one end of the power house mounted on a gallery and consists of 14 marble panels provided with the necessary switches, measuring instruments and automatic circuit breakers. This board controls the low tension circuits, the high tension switching apparatus being located below the gallery.

The arrangement of the St. Gilles central power station which was installed by Maschinenfabrik Oerlikon for the "Societe Nationale des Chemins de der Vicenaux," may be noted from the accompanying drawing, Fig. 6. The power house covers an area of 1,315 square meters, of which the engine room occupies 401 square meters and the boiler room 598 square meters.

The engine-room floor is four meters higher than the boiler room, the former being placed two meters higher than the ground level, and the latter two meters below the outside level in order to facilitate the coal and water supply as well as the connection for the latter.

There are installed in the engine room and dynamo room three direct-connected units, the engines being of the horizontal tandem-compound type. The steam generating plant consists of four boilers of

FIG. 3.—SWITCHBOARD GALLERY IN ANTWERP STATION, BELGIUM.

which one is held in reserve. The coal is carried from the storage room to the boiler in automatic coal cars operating on a narrow gauge track. The boiler room and engine room are lighted by 120 in-

candescent lamps and eleven are lights, and the workshop is equipped with lathes, drills and other machine tools, electric power being used. The shaft-

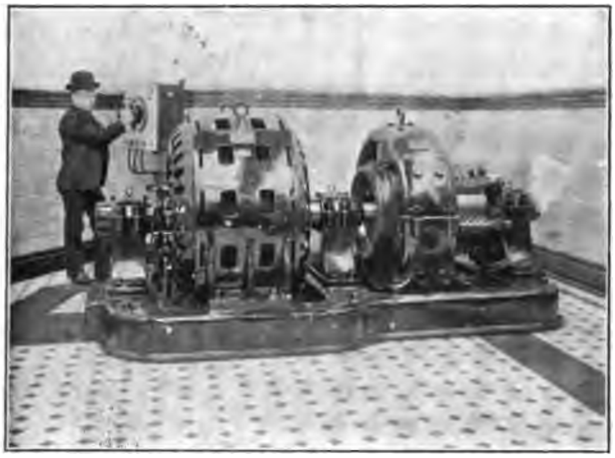


FIG. 4.—70 K.W. BOOSTER IN SUB-STATION, ANTWERP, BELGIUM.

ing of the repair shop is driven by a seventeen horse-power motor from the 550 volt circuit, the speed of the motor being 760 revolutions per minute. The smokestack is thirty-six meters high and 2.15 meters in diameter, the opening being 1.55 meters in diameter. The Galloway boilers operate at a steam pressure of 8.5 atmospheres with a normal output of 1,500 kilogrammes per hour. The boilers were constructed by the Societe Anonyme de Chaudronnerie et Fonderir Liegeoises and having a heating surface of 100 square meters and designed for a pressure of nine atmospheres. The boilers are 2.2 meters in diameter and 10.4 meters long. The two heating tubes are 825 millimeters long. Each boiler has eight Galloway tubes, and Siemens-Martin sheet iron is used, the bottom of the boiler being constructed of material twenty-two millimeters in thickness and the balance nineteen millimeters in thickness, while the fire-tube wall is fifteen millimeters thick and the dome wall fourteen millimeters, the bottom of the dome being of cast-iron forty millimeters in thickness.

The Green economizer has 288 tubes in three groups. Rain water is used for feeding the boilers in connection with the city waterworks and the "La Haye" coal mine drainage for condensation purposes. The feed water is heated to a temperature of 80° Celsius, and pumped by two Worthington pumps, having each a capacity of eighteen cubic meters per hour, one being held in reserve.

The engine equipment consists of three horizontal tandem-compound engines directly coupled to direct-current, shunt-wound generators. The engines are worked condensing and are supplied with Corliss-Bonjour valve gear. The engines were constructed by the Societe Anonyme des Anciens Ateliers de Construction Van den Kerchove of Ghent. The diameter of the high-pressure cylinder is 430 millimeters and the low-pressure cylinder measures 740 millimeters in diameter, while the stroke of the engine is 1,000 millimeters in length and the speed 120 revolutions per minute. The steam jacket of the high-pressure cylinder is heated by fresh steam and the low-pressure cylinder by dry steam from the high-pressure cylinder. The air pumps are located below and are driven from the flywheel. The engines each developed 320 horse-power at a pressure of eight atmospheres and fourteen per cent. cut off and a useful output of eighty-six per cent., while 550 horse-power is obtained with a twenty-eight per cent. admission and 91.5 per cent. useful output

FIG. 5.—REVOLVING FIELD ALTERNATORS IN THE ANTWERP STATION, BELGIUM.

effect. The steam consumption, with a normal pressure and 320 indicated horse-power at normal speed, is 5,800 kilograms per hour with the injector water at 15° Centigrade.

The continuous-current generators are directly coupled to the steam engines by flexible couplings, and the dynamos are shunt wound, as they are used in connection with a storage battery plant. The pressure of these machines may be regularly by hand from 550 volts to 600 volts, and they are constructed to stand an overload of 25 per cent. for several hours, the normal capacity of each machine being 250 kilowatts. The efficiency at full load is 92 per cent. The dynamos are of the Oerlikon multipolar type, the armature being 2,000 millimeters in diameter and the core with 400 millimeters. The machine has eight poles and operates at 120 revolutions per minute, and the laminated iron armature core has 500 slots, in each of which there are two copper bars of a cross-section of 3.5 millimeters by 13 millimeters and 5.5 millimeters by 12 millimeters. At an output of 250 kilowatts and normal speed the current developed by the armature is 460 amperes.

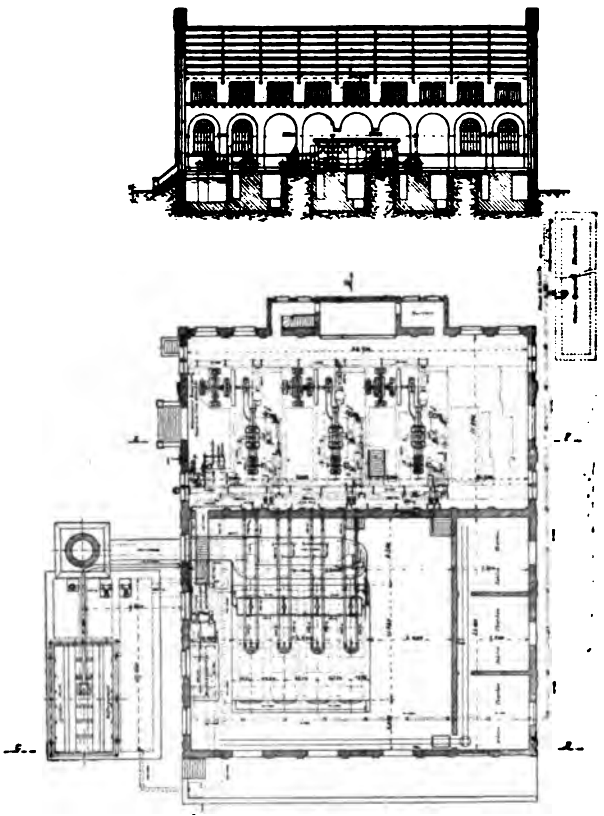


FIG. 6.—PLAN OF ST. GILLIS CENTRAL STATION.

The commutator of this machine has 506 segments, the width being 130 millimeters, while the diameter is 1,400 millimeters and there are eight sets of brushes, four in each set. The field poles are of cast steel 380 millimeters in diameter, and each of the shunt-wound coils has 1,500 turns of copper conductor, having a section of 2.8 millimeters by 3.2 millimeters. The total weight of the field magnets is 6,500 kilograms for the cast steel and 1,150 kilograms for the copper, while the armature laminated iron weighs 4,700 kilograms, the copper bars 620 kilograms and the commutator segments 320 kilograms, making a total weight for the armature of 8.8 tons or more than 17,000 pounds. These machines when supplied with 370, 415 and 465 horsepower by the compound engines at a normal full load and overload develop at a speed of 120 revolutions and a pressure of 550 to 600 volts, 250, 280 and 315 kilowatts and at full load (250 kw.) have an efficiency of 92 per cent. With half load the machine has an efficiency of 87 per cent., and at two-thirds load an efficiency of 90 per cent.

The total efficiency of the electrical and steam units of this plant from the indicated output at the steam cylinders to the terminials of the generators is 83 per cent. at full load, and 81 and 87 per cent. at two-thirds load and one-half load, respectively.

Near the switchboard of this plant there is located a motor-generator set of twelve kilowatts' capacity, for use as a booster in charging the storage batteries. The motor operates upon the 550-volt power circuit and has a capacity of fourteen horsepower, while the generator of the group, driven at a speed of 1,200 revolutions per minute, supplies a current of from 30 to 200 volts pressure, an insulated elating coupling being used in their direct connection.

The accumulator installation is 2.6 kilometers from the power house, and consists of 270 elements as a capacity of 200 ampere hours when discharged at a 300 ampere rate. The voltage at the power house is from 580 to 600 volts, while at the storage battery plant the pressure is regulated by the accumulation to from 540 to 550 volts.

The electrically-driven transfer table in the car barns has a capacity of twelve tons and is twelve meters long. It has a speed of operation of forty meters per minute when fully loaded. It is driven by a nine horse-power electric motor having a speed of 750 revolutions per minute, which receives its current from the 550-volt circuit. The weight of the apparatus complete is 14,000 pounds.

The power house is operated day and night, and

the staff consists of nine men, including two engineers, two assistant engineers and a chief engineer, as well as machinists and helpers. The total cost of the plant, excluding the building was 500,000 francs.

Prepared for THE CENTRAL STATION by Colin P. Campbell, Attorney.

Negligence Where a Wire, Carrying Heavy Current, was Left Wound Around a Fence.

The bill of exceptions showed that the defendants operated a power plant in Cove, in the State of Oregon, and there generated electricity, which it transmitted on overhead wires 17 miles westerly to La Grande at a pressure of 23,500 volts, and by a branch from the main line, starting at a point about 5 miles from Cove, is carried a current at the same voltage southerly 8 miles to Hot Lake and supplied for substations at both termini to customers who use it for light, heat, or power. The injury complained of occurred on the branch line where it runs south on the west side of a public highway extending through the farm of Frank Hempe. This line consists of three uninsulated wires, one of which is suspended from the tops of poles about 30 feet high, set about 125 feet apart, and the other wires are attached to such poles near the top. A very severe wind arising, Sunday, August 27, 1905, at about 4 o'clock in the afternoon, blew a green limb from a tree growing on Hempe's land across the wires, causing two of them to burn off and fall, so that the ends thereof, in the direction from whence the current came, lodged, one against the pole by which it was suspended, and the other on the ground, where it emitted sparks, setting fire to dry leaves; and, some cattle being near, John W. Minnick, who with his employees were threshing grain for Hempe, apprehending danger, by using a dry stick, looped the wire over the end of a picket in a fence inclosing a lawn about Hempe's house, pushing the noose down against the upper rail of the palings. The loop placed over the picket not appearing to be securely fastened, Minnick bent the wire more, still using the dry stick for that purpose, and, wondering whether it still possessed electrical energy, he put out his finger, and when it came within about 8 inches of the wire a blaze suddenly appeared, burning his hand and causing him to fall insensible, from the effects of which shock he did not fully recover for several days. Minnick's son, seeing his father fall, immediately ran to his assistance, when, coming in contact with the wire that was lodged against the pole, he also received a shock. Soon after the wires fell, a dog chasing cattle away from the place of danger also came in contact with the electric current. When the end of the wire was fastened to the fence, Hempe's son, George, was present and knew that the several shocks were so received. Leonard Carroll, who was 24 years old, was working in August, 1905, for Hempe as a farm laborer. He was not at the home of his employer, however, when the wires fell; but, returning that evening, he ate supper with the family and also breakfast the next morning, at which meals the dangerous condition of the wires was freely commented upon, the several shocks received therefrom were adverted to, and at breakfast Hempe, in his hearing, warned the persons participating in the repast to keep away from the broken wires, as by approaching them they might be killed. Carroll assisted that forenoon in hauling oats from Hempe's field to Minnick's machine to be threshed. About 12

o'clock that day, as George Hempe, who was nearly Carroll's age, was returning to the house for the midday meal, he concluded to ascertain whether or not the broken wires, which had not been repaired, were still charged with electricity, and going inside the enclosure to the place where the end of the wire towards the power house was fastened to the picket fence, he expected to make a test with a green weed suspended from a dry stick. Carroll went with him, and, standing at his left about two feet north of the point where the end of the wire was fastened, he seized the top of one of the fence pickets with his left hand, and, in his ignorance of electricity pointed his index finger toward the wire, which was about 8 inches distant, when there was a sudden flash, burning his hand and killing him.

The care which the law exacts from any person, firm, or corporation, engaged in operating an instrumentality is always in proportion to the degree of danger reasonably to be apprehended from the use of the means employed. Electricity is a natural force, the power of which is fully comprehended only by experts, who may be aware of the measure applied, and, when such instantaneous energy is transmitted, either in large quantities or at high voltage, the wires conducting it should be placed and kept beyond the reach of common people who have no conception of the extreme danger to which proximity to, or contact therewith will necessarily expose them. This danger is augmented by the falling of electric wires in places of common resort, and the peril is enhanced by the length of time the wires remain down in such localities. Without attempting to discuss the defendant's alleged excuse for its failure sooner to discover the break in the wires on the branch line, we shall take for granted that permitting a wire charged with 23,500 volts of electricity to remain, for about 20 hours, fastened to a picket fence, beside a public highway, in such a condition that any living creature coming in contact with such wire must necessarily suffer death, affords *prima facie* evidence of negligence.

Having assumed, without deciding, that the defendant's want of ordinary care in failing sooner to repair its branch line was the primary cause of the injury complained of, it remains to be seen whether or not the testimony introduced by the plaintiff shows that Leonard Carroll was also guilty of negligence contributing to his death. It has been repeatedly held in this State, in actions to recover damages resulting from a personal injury, that, if it appears from the testimony offered by the plaintiff that the person sustaining the hurt was also guilty of negligence, without which the injury complained of would not have happened, such proof, as a matter of law, will defeat a recovery.

It will be borne in mind that Carroll was 24 years old at the time he received the fatal shock, and his age precludes the application of the prevailing rule as to the liability of railroads for injuries sustained by children while playing on turntables, or for hurts sustained by persons of immature years from other instrumentalities which they, by the carelessness of others, are permitted to approach. Carroll probably did not know that the wires transmitted such a high voltage of electricity. He had been employed at Hempe's farm about a month prior to his death, and, having frequent opportunity to observe the condition of the wires, he must have known that they were uninsulated, and were used for supplying electricity for lighting purposes. As he must have been aware of these facts, he ought also to have known that contact with a wire, transmitting sufficient electricity for general illumination, was extremely dangerous, and he should have accepted the advice of Mr. and Mrs. Hempe and remained away from the broken wires. Instead of obeying these warnings, he evidently, like Minnick, desired to see how near the wire he could place his finger without sustaining a shock, and, his hand coming in contact with the wire or within its danger zone, he was killed.

We think his act in this respect shows such contributory negligence as to prevent a recovery of the damages sustained, and hence the judgment is affirmed.

Carroll v. Grand Ronde Electric Co., 84 Pac. Rep., 389.

The Law Relating to Electricity, Central Stations and Power Companies.

III.

FRANCHISE AND POLE RIGHTS. FRANCHISES CONTINUED. RIGHT TO ERECT POLES AND LAY CONDUITS CONTINUED.

At the close of the last article we had just commenced the discussion of the rights to erect poles and lay conduits in their application to concrete

cases. A few more cases are still of sufficient importance to warrant slight attention and the first of these is Callen vs. Columbus Edison Electric Co., 66 O., St. 166, 64 N. E. Rep., 141. In this case it was held, that the placing by a private lighting company of poles at the curb in a street and the stringing thereon of electric light cable and wires for the purpose of furnishing light and energy to private parties is a diversion of a street from the purposes for which it was dedicated and is a taking of the property of the abutting owner within the provision of the constitution, forbidding such taking without compensation and such placing of poles, lines and wires in none the less and unauthorized taking, even though it be consented to by the city authorities. Under these circumstances upon the same authority an injunction will issue when it appears that the work is being done by the lighting company without the consent of the adjoining owner and that their maintenance will work injury to his property.

It is absolutely essential to the right of an electric company to use the streets of the municipality for the delivering of electricity to its consumers, that the manufacturers of the current have a franchise or grant of the right from the municipal government or the State to make such use. It is true that the right to produce and sell electricity as a commercial product is a right open to all and it is only when this right involves the use of public grounds and streets that the franchise or grant from the public becomes essential, and its existence may not be presumed, but must be proved by the person or corporation claiming the franchise right.

Purnell vs. McLane (Md.) 56 Atl. Rep., 830.

The right of adjoining owners, so-called, giving the abutting owner, where the fee or highest title to the land upon which the street is laid was in a municipality, the right to enjoin certain operations in the street has been held not to permit the abutting owner to enjoin the occupation of the street in front of his premises with poles and wires unless he is able to show some irreparable individual injury peculiar to himself and not inflicted upon all the public alike. Under this decision, however, it would not be permissible for the company to so erect its poles and string its wires as to interfere with the property of the abutting owner, or to place its poles in such place as would interfere with the abutting owner's right of egress and ingress.

McWethy vs. Aurora Electric Light Co., 202 Ill., 218.

The Illinois Appellate Court, however, in the case of Goddard vs. The Chicago and Northwestern R. Co., 104 Ill. App., 526, held that the transmission of electricity for the purpose of power, light or heat on poles in a highway, either as part of the system of poles already there for use by a street railway company, or upon an added system, is an additional servitude, and the abutting owner is entitled to enjoin such use of the highway by the electric company. In this case there is also this feature, that the pole line was to go across the line of the Chicago & Northwestern Railroad Company. It did not appear from the facts that any interference with the railroad's rights or with the operation of its cars or trains, was contemplated. The Court, however, laid the proposition down that such an occupation of the street across the railroad company's right of way was an additional servitude and should be restrained. This leaves the law in a somewhat unsatisfactory state, and it is to be hoped that the matter will finally be put at rest by a decision of the Supreme Court of Illinois, disposing of the questions in that State, whether or not poles and wires are an additional servitude, when the abutting owner's title extends to the center of the street. As we have already noticed there is other authority upon this point.

In Pennsylvania the Supreme Court in the case of Brown vs. Radner Electric Light Company, 208 Pa. St., 453, held that the company under a franchise from the State conferred by general law was entitled to enter upon the bed of a turnpike road, and use such roadbed for the purpose of erecting poles and stringing wires notwithstanding the objection of the abutting owner. The electric light company, however, conceded in this case that they were bound to pay damages to the abutting owner for injuries sustained by reason of the erecting of the poles and stringing wires and tendered a bond for such damages to the abutting owner which he refused. It will, therefore, be seen that this case does not hold that the electric light company may occupy the street without paying damages, but may by virtue of the power of eminent domain, which we will subsequently discuss, so occupy upon the payment of damages.

In New Jersey, the statute requires electric light companies to obtain the consent of the owners of the soil before they erect their poles and string their wires in the public highway.

Pt. Pleasant vs. Bay Head, N. J., ch. 49 Atl. Rep., 1108.

It must be concluded, therefore, that by the great weight of authority in this country, the right to the erection of poles and stringing of wires is an additional servitude as against the owner of the adjoining property which the franchise or grant from the public will not permit the electric company to violate without the payment of damages to the abutting owners.

RIGHT TO TRIM TREES.

One of the most important questions in this discussion is what right has the electric company to trim trees along the highways as against the abutting owner. It must be apparent that if the electric company has no right to occupy the highway as against the abutting owner, the company has no right to cut or trim the owner's trees without his consent, and this is true even though the trees are in the highway and when those trees are planted there by virtue of a municipal ordinance or under a statute permitting such use of the highway electric light and power companies have no right to prune the trees and if they do prune trees or if the trees are injured by reason of the proximity of the wires and poles, the company will be held liable to the abutting owner for this damage caused by their acts.

Bronson vs. Albion Telep. Co. (Neb), 60 L. A. R., 426.

The same is the law in Wisconsin where it was held that when an electric light company, pursuant to an ordinance authorizing it to set poles in the street, sets a pole or strings wires in such manner as to make the trimming of shade trees essential, it will be liable for such trimming.

Malone vs. Waukusha Electric Light Co., 98 Wis. N. W. Rep., 247.

Discrimination in Municipal Lighting

By J. S. Codman.

It is pretty generally assumed that when a municipality goes into the electric lighting business with its citizens for its customers, it is proper first, that it should show no discrimination in its dealings with its customers and, therefore, second, that it should sell its current at the same price per unit of consumption, that is, per kilowatt-hour, to each customer.

It should seem that as regards the first assumption there can be no argument, but are we certain that the second follows logically from the first? In the opinion of the writer it does not. The second assumption would be a correct one if the cost of furnishing a kilowatt-hour were the same under all conditions; but as this is very far from being the case, a tariff based on a fixed price per kilowatt-hour becomes discrimination of pronounced form.

Electric energy cannot readily be stored, but must be manufactured at the moment of demand. For this reason the maximum demand of the customers of an electric light station determines the amount of the station's investment in boilers, engines, dynamos and distributing apparatus, and in part determines the investment in real estate and in buildings. For instance, let us suppose that the maximum demand on a particular station is 10,000 lamps, that is to say, 10,000 lamps is the maximum number lit at any one time. The boilers, engines, dynamos and distributing mains then must be large enough to carry this load of 10,000 lamps, and it makes no difference in the amount invested in the above apparatus whether this maximum demand of 10,000 lamps lasts for one hour a day or for ten hours a day, or, in other words, this investment is determined wholly by the maximum demand on the station and not by the output in kilowatt-hours.

Now, owing to the nature of the present call for electric current, it happens that a station furnishing electric current sells only a small percentage of the electric energy which it would sell if the maximum demand were maintained continuously. This percentage is technically known as the "load factor," and lies pretty generally between 8 and 20%. The interest, depreciation and other expenses which are independent of the output are, therefore, relatively very great, and in fact, may be shown that they amount nearly always to more than 60% of the total expenses exclusive of dividends.

The larger the output in proportion to the maximum demand, that is the greater the load-factor, the less will be the relative size of the investment charges as compared with the total expenses, and the less will be the average cost per unit of output, that is per kilowatt-hour. Further, since the maximum demand on the station is determined by the individual maximum demands of the customers, and its output by their consumption, it follows that the customer whose consumption bears the highest proportion to his maximum demand, that is the cus-

tomer having the highest load factor, should receive the lowest price per kilowatt-hour. In fact, the cost of supplying a customer is very nearly in proportion to his load factor.

Now, since the cost of supplying each customer is nearly proportional to his load factor, it is evident that the rate of profit from one customer will be different from that from another, if a flat meter rate per kilowatt-hour is charged. In actual practice the differences will be very great, and in fact, there is probably not in the country, a station which charges a flat meter rate where some customers are not actually furnished at a loss. A flat or uniform meter rate, therefore, means discrimination.

It should now be pointed out that with prices bearing a definite ratio to cost of supply, the lowest average price per kilowatt-hour can be given. For let us suppose that we have such a scale of prices and that we deviate from it, thereby raising the price to some customers and lowering it to others, with the intention, however, of maintaining the same average price. It will certainly result that some of the customers on whom the rate of profit is increased will be lost to the company, while new ones will be obtained at a reduced rate of profit. This will mean a reduction in the average rate of profit, which will necessitate a rise in the average price, and this again will reduce the business of the company necessitating a still further rise.

On the other hand, if we have a scale of prices which are not proportional to cost of supply, and we change to one that is proportional, with the intention of obtaining the same average price, it will result that some customers will be lost who were previously being supplied at a loss or at too small a rate of profit, while new customers will be obtained at a larger rate of profit. The average rate of profit will therefore rise, which will permit the reduction of the average price and this will increase the profitable business of the company, permitting a still further reduction.

To sum up, it may be stated that a uniform price per kilowatt-hour not only means a variable rate of profit on customers which is improper, but also means a higher price per kilowatt-hour to the customers as a whole.

It may be objected that it is impossible to make a schedule of prices proportional to the cost of supply and that therefore a uniform price per kilowatt-hour is the best. It is probably true that a scale of prices exactly proportional to costs is practically impossible to obtain, but nevertheless it can be approached very closely. Various systems of charging with this end in view are already used by many private companies, which fully realize that reduction in the average cost makes possible a reduction in the average price and a consequent increase of business.

The above-mentioned systems of charging are all based on the general principle of charging the customer for his capacity as determined by his maximum demand in current and in addition charging him for his consumption by meter. These systems, as before stated, have come into general use among the private companies, and have been described and discussed at conventions and in the technical press. Space does not permit of describing these systems here, but the writer has discussed them in some detail in a paper read before the Association of Electric Lighting Engineers of New England and entitled "Discrimination in Rates," which paper was published in full in the *Electrical Age* for June, 1906.

New Engine and Boiler Catalogue.

The James Leffel & Co., Springfield, Ohio, have issued a very handsome and complete new 52-page catalog, illustrating and describing their line of steam engines and boilers. The details of construction are plainly shown and fully explained, and the catalog is one that should be in the hands of any prospective purchaser of work in the steam power line. A copy will be furnished free to prospective buyers, stating their wants, and addressing the company as above.

In writing for this catalog please request Catalog "O."

The Crocker-Wheeler Company have now completed arrangements and have opened an office and warehouse at 208 First street, near Howard, San Francisco, Cal., with Mr. H. C. Baker as local manager.

They have also opened an office at 447 Pacific Electric Building, Los Angeles, Cal., with Mr. L. Cummins as representative, and are arranging to establish an office in Seattle, Wash., in the near future.

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What High Tension Means.

The subtle distinctions made, between apparently synonymous conditions, are as fine as those discovered in an analysis of the true meaning of words. The fact that high tension transmission is established does not entirely explain the whys and wherefores of the process. In fact, the mere application of high tension is not by any means an explanation of its commercial usefulness in power transmission. As a rule, it is believed that all necessary explanations are found embodied in the statement: that copper in the transmission lines is saved. The truth of the matter is, that this as a financial temptation would be ineffectual, were it not for the fact that all apparatus pertaining to high tension transmission, permits of this economy in theory as well as practice.

To develop this idea, it is readily understood that the elasticity of a power transmission system depends upon the ease with which the said power can be transformed into direct or alternating current; were the expense of this change prohibitive, it would not be made except under extraordinary circumstances. But this in itself is notably an important link in the chain of events, and, in consequence, permits of changes from high to low, or from low to high pressure, with comparative impunity.

But high tension, on this basis, becomes a commercial proposition not only because it means a saving in conductor cross section and degraded energy in the wire, but because the added expense associated with the moving of power in this manner from place to place, is only commensurate with the amount of power moved. At present, the extent of such operations does not exceed two hundred miles; though there is every reason to believe in greater extensions than this in the near future. But whatever may be the consequence of such great enterprises financially, industrially or otherwise, the rock upon which this system is reared is insulation. Curious as it may seem, the word in itself is comprehensive more particularly in the case of high tension, than low tension propositions. The logic of events is such that whereas economical transmission means high tension electricity, high tension electricity means adequate insulation. When pressures of 60,000 or 100,000 volts are utilized, the supporting insulators have a purpose to fulfil that makes what is ordinarily understood as insulation appear like an amateur effort in this direction. It can be readily seen that insulation is the point at issue, whenever high tension power is transmitted. What this insulation costs, is to a large extent as important, if not more important, than any other feature of the line construction. The cross section of the conductors is thus seen to be only one part of the problem, not only scientifically but practically. What the insulators are and what the insulation is, is the vital question of the hour. It is more the vital question to-day, than ever before, because plans have been projected considering the use of enormous pressures, and it is readily seen that success in such work will spell primarily success in insulation.

Hydro-Electric Plants.

The so-called hydro-electric plant is now a feature of our American engineering schemes in the East as well as the West. It is distinguished from ordinary propositions in the sense that it is presumably a more profitable enterprise because of the comparative cheapness of the power it utilizes. But the economy which is supposed to be the main influence in its organization and installation is based upon conclusions derived from such governing factors as the drainage area, inches of rainfall, and head of water and stream flow. In other words, the case is not as simple as it first seems, because of the influences which are operating meteorologically for or against an investment of that character. The old proverb that "all is not gold that glitters," indeed has a direct application here, for the reason that commercial advantages and not merely engineering possibilities deserve first consideration in the plan to made use of water power for industrial purposes.

There are a great variety of such plants of greater or less dimensions dotting the surface of the United States. Their individual histories from their inception would be deeply interesting if known, catalogued and compared, because of the variety of experiences they would represent of an agreeable and a discouraging character. All are not, as called, hydro-electric plants, but some are hybrid in nature, because of the necessity imposed by the lack of rain or fall of water to use steam power at certain seasons of the year. The short-sightedness which led to a disregard of the conditions prevailing in certain localities, was in the majority of instances the cause of the additional steam installation. The only hope of financial rejuvenation in such a case, was to get enough business to keep both the water power and steam in operation conjointly as long as possible. To whatever extent this may be accomplished, however, at some time in the year, when the water power falls very low, the prevailing conditions cause a lapse in the operation of the water power division. In other words, one part of the investment becomes unproductive, and therefore a losing proposition during the period of its inactivity.

But the hydro-electric plant as ordinarily understood is not hybrid in character. It is generally a plant whose installation is the result of a well thought out plan of procedure. It may in addition be regarded as a case in which the meteorological conditions have not been forgotten. Success can only be attained when water power plants are installed, if the water power averages up during the year to a reliable value. Students of physical geography are more apt to know the nature of the climatic conditions prevailing in a given section of the country, and what may, therefore, be expected in the way of water at certain seasons of the year, than the ambitious but unobserving promotor of electrical enterprises, too much occupied with the success of his scheme to correctly estimate the annual or periodic rainfall, and its bearing upon the continuity of the electric power to be produced.

For this reason it is readily realized that the average hydro-electric plant must be rated as a plant of varying capacity. This capacity is at a maximum when the water power is fullest; it is at a minimum when the water power is least.

The auxiliary steam plant that may be installed, is simply utilized to meet the excessive demand for power in exceptional cases. This demand may be, and generally is greatest, when the water fall is at its lowest value. The steam auxiliary, therefore, simply takes the place of an addendum to the plant, to help the high load curve at certain seasons of the year. The position may be taken, that the hydro-electric plant itself is only an auxiliary to the steam plant, depending entirely upon the amount of water power available for power purposes of this kind. If the water power is small, and the demand for power great, it may readily prove only an auxiliary to the steam plant. On the other hand, as already indicated, the water power may be quite heavy enough to represent the greater nucleus of the plant. From whatever standpoint the case may be regarded, hydro-electric plants only deserve serious consideration, when they successfully accomplish a definite purpose. That purpose is the profitable transformation of water power into electrical energy and not merely its reduction to such. Or to be still more explicit, the element of success, in a strictly business sense, is by far more the means of judging the plant, than either the quality of its machinery or the size of its load. On this basis water power plants cannot mean anything if they do not net dividends bearing a proper relation to the investment as in any other case of power generation.

Underloaded Machines.

Central station economy is based upon the observance of certain principles, whose crystallization

results in an efficiency of operation of a distinguishing character. But economy as so expressed is not sufficiently explanatory, unless the source of its being, as it were, is made clear. In other words, the technical significance of efficient operation, in an analytic instead of a collective sense, is discovered in the individual operation of machines. For this reason, light may be cast upon the problem by classifying machines in service, other things being equal, as machines that are, and are not, underloaded. A theme of much practical, as well as theoretical, interest, is thus derived from a casual investigation of current conditions in and out of central stations. The practical interest attached to data of this type is due to the effort made to raise standards of operation to their highest point in central stations, and in consequence anything which is of value in attaining this end, even hypothetically, is readily assimilated.

The situation discovered, however, is not one which can be called merely hypothetical, but real. It is that of machines built to do a certain amount of work, not doing it. It is that of a comparatively large aggregation of machines, falling far short of their proper quota of load, not because of incapacity or defectiveness, but due to conditions of service which prevent them from accomplishing the quantity of work for which they were originally designed. The case in point is that of a central station whose equipment is complete, fulfilling to the letter the consulting engineer's plans, yet in spite of the character of the equipment failing in the final accomplishment desired, namely: that of representing in actual practice a station of efficient operation. The units, therefore, whether large or small, must not be underloaded. Discretion in apportioning the load, is a matter of direct concern, both with reference to the outside load as well as the degree to which it is placed upon a certain machine or machines. The idea, therefore, which should prevail with respect to the station units and the load is that the distribution of the load is made in such a manner that each machine in turn is properly loaded. It is readily understood that the installation of too many units, or of units of too great a capacity, would mean inefficiency in service. The distinction that should be made, therefore, is inevitable, that there is a great difference between the efficiency of a machine as a machine, and its efficiency at points of load such as one-quarter, one-half or three-quarters.

Underloaded machines, therefore, are one of the drains of a station, as well as a loss to power users. The argument does not end with the station, but extends outside of it. The consumer of power using a motor too large for his purposes is affected financially in a bad way. He is paying for something he gets but cannot use. The reason why he cannot use the power economically is a fatal one, one in fact that cannot be gainsaid. The advisers of such a man at the time he purchased his motor, probably told him to get one large enough for all future contingencies.

If a ten horse-power was needed, the purchase of a fifteen or twenty horse motor instead, would naturally mean a motor running well under load. The same principle in station service, in the purchase of units so large, that at all times one of them at least is operating much under full load, cannot mean anything less than uneconomical operation. In a station, generators must, if possible, be kept at full load. Perhaps one of the reasons why smaller generators under such circumstances pay better is that they have a full load efficiency, which is higher than the half load efficiency of a much larger machine. While it may be justly stated that the economy of a station is measured by the rate at which coal is consumed, it is also evident that the purpose in installing highly efficient engines and dynamos is lost, if the generators they directly and indirectly operate, though of inherent constructive efficiency, are run at points of load which obliterates such advantages. An estimate of the number of underloaded machines in operation of a type whose economy of action is depended upon full load, would reach surprisingly high figures. The best that can be done to recapitulate, is to try to distribute the station load at least, so that its generators are doing their work with commendable economy.

The central stations of this country are very rapidly awakening to the necessity of giving their customers not only the maximum amount of light but also the best illumination possible. An example of this awakening to the need of better illumination is that of the Portland General Electric Comapny, Portland, Oregon, which has secured the services of Mr. H. M. Lauritzen of the engineering department of the Holophane Glass Company, for a period of two months to assist them in the designing of lighting of numerous installations which are now under way to assist the architect in the correct

laying out of the lighting scheme before the buildings are wired; also to instruct their salesmen to lay out the lighting in order to get the best illumination possible. So great has been the demand for this class of work that the Holophane Glass Company announces for the present no more engagements can be made for members of their engineering staff for this class of work.

CURRENT IDEAS

For Furnishing More Light, Heat and Power from Central Stations.

Organization and Conduct of a New Business Department Suitable for Central Stations in Cities of 50,000 Population and Under.

By S. M. Kennedy.

There is probably no other kind of business in America to-day which is capable of as much development as is the selling of electric energy. At first glance, this may appear to be a bold assertion, but the more the subject is considered, the more the truth of the statement will become evident. There are countless opportunities for working fields only partially cultivated, for plowing and sowing fields now lying fallow, and for reaching out into the deserts and making them "blossom like the rose." It matters little what may be the relative size of the city in which a central station is being operated —whether it contain 5,000, 50,000, or 500,000 population, the opportunities are there in each case and almost begging to be looked after. However, opportunities are not in the habit of rushing at those who sit down and wait for them; they require to be sought. But many a man who is sincerely looking for Opportunity will be surprised to find that Opportunity has been looking for him, and anxious to meet him more than half way. Electrical opportunities are everywhere in any city, on the streets, in the home, in the office, in the factory, in the store, and in the workshop—on the surface, overhead and under ground—wherever men and women live, labor, eat and sleep.

NEW BUSINESS.

There is no standing still in the electrical business, and a central station is either going ahead, or falling back. As a matter of fact, a really healthy electric company should be behind with its new work most of the time; should be rushed with orders and straining to keep up with them. It is not meant by this that there should be inefficient methods, or insufficient help, but that the pressure of constantly increasing demands for electric energy should be impatiently pushing forward the orders awaiting their turn for attention.

But this great pressure of work, these insistent demands for attention—what are they? Just the visible indications of opportunities which have been stirred up, and opportunities which have been met on the way in. And the central station will obtain the full avantage of these opportunities by means of its "New Business Department."

OBJECTS.

The great problem which central station managers are trying to solve, is one of equalization. It is highly desirable to increase the sale of electric energy in every legitimate way, but some ways are more profitable to a company than others. In a growing city it is an easy matter to build up a "peak." But it takes efforts and brains to broaden the "peak," to build up a day load and to reduce the difference between the peak load and the minimum demand. These are prime reasons for the existence of a "New Business Department." It is to this department that the central station manager must look in orer that he may obtain a proper load for every hour of each day, and every day of the year.

FOUNDATIONS.

In organizing such a department, it is well to consider what are the requisite foundations upon

which to build: In the first place, there should be a corner stone on which is graven the words: "Electricity for Everything, and Everything for Electricity." This should be adopted as the motto and slogan for all connected with the department. With such a corner stone, the remainder of the foundation should consist of: (1) Energy—untiring, unswerving energy—the kind which never stops. (2) Vigilance—the watch-dog of progress—the sleepless element which takes advantage of every opportunity. (3) Alertness; quickness to see an opening for business, and readiness to act upon it. (4) Aggressiveness; so that old methods and conditions may be succesfully combatted and changed to conform with modern ideas. (5) Persistence; in order that prospects may be converted into actualities. (6) Knowledge; which is the mother of good judgment. And (7) Enthusiasm; the quality which compels by force of belief—the combination which oils the mechanism of a business and cements the forces for a common cause. These are the principal elements which are required as a safe foundation for a New Business Department, and with a proper admixture of each, the superstructure will grow of its own volition.

STAFF.

A New Business Department is no longer considered an experiment or a fad—it is a necessity in the operation of a central station. The generator is the heart of the plant, but the New Business Department is the lungs. A man cannot get along without a heart, neither can a central station. A man can get along with only one lung, or part of a lung, but he will die if the part shrinks up too much—and so will a central station. For cities of 50,000 population and under, the staff of a New Business Department proper, may consist of from one to twelve individuals, depending altogether on the size of the city, the local conditions, and the rate of speed with which certain objects are to be attained. There has been an inclination in some quarters to look upon this department as an extravagance, which tended towards excessive plant investment. But this theory is easily exploded. A properly organized and well operated New Business Department not only points the way to profitable extensions, but increases the value of present investments by developing paying business existing under a company's lines and selling energy during those hours when it would otherwise be wasted, or, at least, not fully utilized. Let the central station manager select a good man to put in charge of the New Business Department, and let that man add to his assistants as he feels the necessity, and as circumstances warrant. An energetic man will soon stir up more business and more prospects in a city of 10,000 inhabitants than he can take care of himself, and he and those laboring with him will have pleasure in watching the growth of the new business added as the direct result of their efforts.

THE WORK.

It is safe to say that no city on this continent, no street, no block, and no house can claim to be properly illuminated, or to have all the electricity consuming devices which might be used with advantage. It is safe to say that in every city of any size there are hundreds of horse power in steam and gasoline engines being operated at a greater cost than necessary, just because their owners have wrong ideas about electrical energy and are not aware of the great advantages to be derived from its use. It is safe to say that there are many electric appliances which could be installed in each household now using electric light. In every community there are many thousands of dollars in revenue waiting to be picked up from the sale of current, the production of which would not increase the central station plant investment to the extent of one cent. As a matter of fact, the people really want to know all about the possible advantages of electricity, and this curiosity should be stimulated and satisfied by the central station, as it is entirely in line with the growth of its business. More light and more power can be sold to consumers, as well as non-consumers—but it must be done by hard work. Men with a knowledge of salesmanship and business methods are required to successfully spread the news of electrical possibilities, to swell the number of consumers, and increase the amount of individual consumption. This is the kind of work cut out and waiting for the New Business Department.

NEW METHOD.

But if it is discovered by a manager that so much valuable business is waiting attention, what must he do to gather it in? Well, there are four ideas which he must grasp before starting on his campaign, namely, that the public requires Education, Instruction, Persuasion, and Demonstration. It is not usual for men or women to want something which they do not know exists. And after they

have been taught that something does exist which would better their condition, they require to be instructed as to its advantages. In a city of 20,000 population, a company may have 3,000 consumers —all using light. Perhaps the manager contentedly leans back in his office chair, and, in answer to an inquiry, says: "Yes, business is good, we keep adding to our consumers right along, and must soon increase the capacity of our plant." And at the same time his load curve may probably resemble the spire of a church as much as anything else! Does he try to broaden his "peak"? Does he try to equalize, so that there may be a profitable day load? Maybe he is too busy to do more work himself. If such is the case, then he had better obtain a means of educating his public. His 3,000 customers could probably be increased to 4,000—but, let us stick to the 3,000. They are all using light—Splendid! What do they want first? More light! It is an axiom, in this business, that the more opportunities there are for using light, the more light will be used. Some of the residences are without porch lights, hall lights, portable lights, cellar lights, outhouse lights, and outdoor lights. The stores want more inside lights—and more electric signs. The factories and workshops need more arc and reflector lamps—good light makes cheerful and efficient workmen, and good workmen deserve good light.

ELECTRIC APPLIANCES.

What next! Do those householders know of all the electric appliances which add so much to the comforts of life? Well, may be they do know of some of them—but not from the central station office. And yet those housewives are ready to use electric toasters, chafing dishes, irons, sewing machine motors, plate warmers, coffee pots, curling tongs, broilers and a dozen of other conveniences. But they must be told about them.

Anything else? Yes, just POWER—but spell that word with capitals, for it usually means day load, and that is what our friend, the manager, is looking for. That city of 20,000 is using lots of power in intermittent and constant operation. How much of it electric? Is the manager going to sit down until new factories start, and wait for the promoters to come to his office and inquire what can be done? If he does, he will probably have few inquiries. Is he going to wait until those existing power users who have steam and gasoline plants meet with accidents and then expect to have them ring him up for information? Well, maybe he'll have a few calls, but he'll have fewer orders.

What must be done to obtain these valuable kinds of business? Educate, Instruct, Demonstrate, Persuade. If you want to sell more light, show your customers that they need more. If you want to derive the increased income from the use of electric appliances without increasing your investment, you must create a demand for the appliances. If you want power consumers to hold your plant down during the daylight hours, then show the power users in your city the advantages of electric energy. They must learn of the convenience, cleanliness, and reliability of electric motor driven power. They must be shown the saving in insurance, interest and depreciation. They must have all these things explained and demonstrated to them.

ELECTRIC IRONS.

The company with which the writer is connected operates in one city with a population of 225,000, and in seventeen other cities with populations varying from 4,000 to 25,000, and has upwards of 30,000 electric consumers. About eighteen months ago it was decided to stimulate the sale of Electric Laundry Irons for use in private dwellings, some hundreds having already been installed in various laundries on the system and found to be giving great satisfaction. Within twelve months there were installed in residences over 1,600 irons, which were all paid for by the consumers using them. Careful data was compiled and it was conservatively estimated that the average monthly income from each iron was sixty-five cents, or equivalent to $8.00 per year. It was also apparent that those who had the irons were highly pleased, and, in numerous instances, were inquiring for other appliances. But many did not have the irons that would gladly use them, who could not or would not spend the money to buy them. Now, here is what the company discovered: Electric irons were good things; day load; lighting rates; no increased plant, line, transformer or meter investment; average income at least eight dollars per year; 1,600 of them installed! Why not 10,000? But the people won't buy them! Well, let's see! Every thousand irons out increases the annual income $8,000; 10,000 irons would mean $80,000! Just like finding it! What was to be done? Invest a little money. Take a little risk. Loan the irons to customers who will use them.

That is what our company has done. The first order placed was for 3,500 irons, and within twelve months from the time the plan was put into effect, the company will have loaned not less than 7,500 irons, and there will probably be in use on our system altogether 10,000 electric irons in 1907. That is one way of getting new business and making it easy to obtain more.

BUYING OLD PLANTS.

One more reference to the means adopted by the same company to obtain power business. It often happens that a power user may be interested in electricity, but he has his money tied up in a steam or gasoline engine and does not wish, or thinks he cannot afford to invest more. During the past two years our company has purchased such plants, in units averaging 20 h.p. each, to an aggregate of over 1,000 h.p. These engines have been resold and shipped to territories away from the company's lines, and their former owners are now invariably strong advocates of electric energy. But engines have only been purchased in this manner where there was no other way of obtaining the electric power business. Owing to the lower cost of motors, most of these exchanges were made without loss to the company, although in some cases it was figured out that an initial loss must be met in order to obtain profitable and permanent power business.

WAYS AND MEANS.

And now we come to the question of ways and means. How is the public to be educated, instructed and persuaded? What is it that the new business department must do to begin with, and what must it continue to do? The answer is:

Advertise,
Solicit,
Exhibit,
Systematize,
Foster Existing Business.

The success of the central station is first dependent upon good service, but most of the different problems in generation, transmission and distribution have been satisfactorily solved, and most managers know how to obtain an adequate amount of energy. But the limits to the sale of electricity have not yet been sighted, and the more these limits are sought, the greater distance they seem to be away.

The New Business Department cannot be divorced from the other departments of the company. It must, of necessity, keep in touch with the operating and construction ends, must be close to the accounting side, and in constant communication with the customers' department. The manager of the New Business Department may not be an engineer, but he must have absorbed a considerable amount of technical knowledge. He may not be an accountant, but he must know how to figure. He may not be a meter reader, a collector or a trouble man, but he must know what are the difficulties in each position. And, above all, he must know the public. He must know its failings, its prejudices, its needs and its opinions.

ADVERTISING.

In the conduct of a New Business Department, the subject of advertising is ever present. It is one of the main stays, and must receive careful attention. But let us take it for granted that the manager acknowledges the importance of advertising—the next question is, what are the best methods of publicity? Probably more than any one else, the man who advertises must put himself in the place of those whom he wishes to reach. With this idea before him, he will understand how to attract the attention of the public, where to place his advertisements, and when the psychological moment arrives, to produce the best results. Now, advertising of any description must attain its object by a well defined process. In the first place, it must attract attention, next promote inquiry, then awaken desire, and finally create a demand. Again it is asked, what is the best medium for doing all this and increasing the sale of electricity? For the reason that the public cannot be all reached in the same way, it follows that all honest advertising is good. Some people never look at the advertisements in the daily papers, but will eagerly scan each advertising page in a magazine. Others never see an ad. in a periodical, but yet their eyes catch the notice on a bill board, or the card in a street car. Again, there are others too absent minded to note anything on bill board or in car, but put a circular or letter in their hands and it will be read from beginning to end. Consequently, if you wish to reach every class, use every medium of attracting their attention. You don't require to go after all at once—but go after them somehow.

NEWSPAPERS.

Newspaper advertising pays in many ways, its returns being visible and invisible. It frequently happens that considerable space is taken in order to propitiate the press. The friendship of your local papers is important. Foster that friendship, but

do not neglest the space you take just because you think it is there always, and the ad. may be changed at the same time. That space is valuable to you in proportion to the circulation of the paper, just as the editor may be valuable to you for the same reason. If your ads. are built right, if they attract attention and *say something*, they will help your business, and increase your income. It is a good plan to tell one thing at a time, to change the copy frequently, so that it may not become stale, and to use a snappy, concise style which will gradually draw a regular following of readers, who will look for your ad. in the paper just to see what you have to say. What you print will be read by consumers and non-consumers. Say something to each. The first named should be using more current. Point out to them where they need more. The others need to begin. Show them where they will be better off. Create the desire. You do not require to be an advertising expert. Know your own business. Be thoroughly acquainted with the public needs. Talk in the ad. as you would to a prospective customer sitting in your office. Attract attention—then be short, direct and crisp, and let your words show that you believe in what you say.

Regarding the many valuable media of advertising other than newspapers, the business manager must, of necessity, be governed by local conditions and his own experience as to the advantages of each class. It is desirable to vary the manner of publicity, but to keep at it all the time, remembering that constant drops of water will wear away the stone, and that indifference may gradually be changed to interest, and antagonism to friendship.

CIRCULARS, ETC.

The mailing of circulars, separately or along with bills, is a successful way of arousing interest, but the circulars require to be carefully prepared—printed on good paper and always artistic. Neat booklets or folders should be interchanged with the circulars, and each should draw attention to one subject only. Bill boards are splendid for special announcements, and catch the eyes of many who will not read the papers. He who runs may read a poster—and many read and remember. Street car advertising is also valuable to impress an idea on the public. If a man is sitting in a car for ten or fifteen minutes and one of your ads. is opposite to him, he will read it whether he wants to or not. And if what you say is catchy or important, he will not forget it.

"FOLLOW UP" LETTERS.

"Follow Up" letters are a dignified and desirable means of drawing the attention of selected people to a subject which should be of special interest, and are always productive of good results. These letters should have a personal touch to them, and should be neat and attractive in style and diction, avoiding altogether the appearance of a general circular. By this means the individuals you wish to reach are talked to without chance or haphazard.

It has been found that one of the best ways of drawing attention to a subject with existing consumers is to use the backs of monthly bills. If you wish to advertise electric appliances useful in a home, put a snappy notice on the backs of the bills. If you wish to have merchants consider window lighting, electric signs, or fans, talk to them briefly on the backs of their bills. Say something different each month. Somehow every man and woman will look at an electric bill to see the amount. When they see the amount let them also notice a bold line reading "See Other Side." They'll turn the bill over and read your ad. That's what you want them to do. The new business manager should do his advertising well, thoroughly, intelligently, and systematically. If he cannot do it himself, or have some one on his staff who can, he had better pay an ad-smith to take the details of the whole matter off his shoulders. But let him advertise and do it right.

ADVERTISING ON BILLS.

Advertising in the electric business is principally to arouse curiosity and invite investigation. Its object is to induce the reader to ask questions, and prepare the way for getting business. But it requires a personal interview to close a contract; and the prospective consumer must either hunt some one up, or some one must hunt him up in order to bring matters to a desirable climax. It is a good plan for a representative of a company to do the hunting. The man who reads the ad. might have good intention, but a bad memory.

SOLICITING.

"The best cause requires a good pleader," and the best managed New Business Department requires good solicitors. There are some lines in which a solicitor requires only to be a good talker. Not so in selling light and power. A good talker is all right, but he must first be honest, earnest and straightforward, and what he says must carry with it the ring of truth. The solicitor goes out among the public. He meets the people in their homes, offi-

ces and places of business. He does not represent himself, he represents the company, and the public is going to judge the company by the action and words of the solicitor. Often he is the only one about the company whom the customer knows. The president, directors, and officers may be men of standing—great men in the community—but the average customer does not knew anything about them. He judges the officers by the kind of men they send out to talk to him. Do not think that any kind of a man can solicit. Have men who *know;* men who can make friends; men who can mix well and men who wear well.

REGULAR SOLICITORS' MEETING.

There is a great difference between a man coming to you to do business, and you going to him. The first presupposes a desire in him to act: the second a desire in you to induce him to act. Consequently, solicitors should be trained and instructed. In this connection it is well for the manager of the New Business Department to gather his staff around him at least three times each week to discuss matters in hand, to answer questions and smooth out difficulties. New conditions are constantly arising which require to be met. Information is constantly coming in which required to be distributed. Reports about new buildings, new building permits and new tenants must be dealt with, and often a daily meeting is necessary—and advantageous. Direct solicitation is the safest and surest way to obtain business, and the solicitor must be equipped for his work. The electric company has much to do to overcome competition, indifference and inertia, and it is through the solicitor that a large amount of this active and passive opposition may be removed. He must educate and demonstrate. He must make the public realize that his company is selling something in which every one should be interested; something that lessens the cares and responsibilities of life; something that is superior to everything else for doing similar things; something that reduces work, lightens labor and saves their pocketbooks from certain ravages.

SOLICITORS' TACTFUL WORK.

It is essential that solicitors should not be too technical in their talks with prospective consumers. There is nothing to be gained in befogging a man by injecting into a conversation a mixture of amperes, ohms and volts. The solicitor is not selling kilowatts; he is selling light. He is not selling amperes, he is selling heat and power. If he has acquired technical knowledge, let him forget it when talking to an ordinary man or woman, and he will sell electric current with less trouble. Those engaged in the electric business are apt to forget that the public does not know as much about it as they do. It is a fact that a very large percentage of the community does not know of the conveniences and simplicity of handling the current—even when they have it for lighting their homes. Many people have a fear of electricity on account of its mysterious nature; some thinking it is dangerous as lightning. Here is where the careful work of the solicitor may do good every day. He can point out the safety of electricity in the home, the impossibility of upsetting electric lights, and, consequently, the reduction of fire risk; the dispensing of matches where there are children and careless people; the abundance of pure air, the saving of doctors' bills and the convenience of the many wonderful electric appliances which are adapted for house use.

To the merchant the solicitor points out the advantages of electric light for showing his goods. For keeping his ceilings and store clean, by absence of smoke and smut, for reducing the heat in summer, and permitting good air at all times. For improving the decoration of his windows and keeping them clean winter and summer, so that the public may see what he wishes to display. And then he shows him the score of electrical devices which may be operated to advantage inside his store, and help him make money. And, lastly, the solicitor takes his merchant to the door and points out how and where an electric sign will work for him while he sleeps; how he can burn his name and business into the public mind, and how the company will take care of the sign, turn the current on and off at the proper times, and relieve him of all responsibility in the matter.

The power user has much to learn, and to a great extent the solicitor must be his instructor. He goes into a factory in the crowded part of the city, and what does he see? Probably 50 per cent. of the power generated wasted and dissipated in shafting and belting before the machine commences to work. Probably ten times as much space as is necessary given up to engines and boilers—and valuable space, too. Probably twice as much money invested in the power end as there should be, and, consequently, twice as much interest and insurance, and four times as much depreciation continually piling

up. He probably finds plenty of noise, smell, dirt and inconvenience, to say nothing of the high priced skilled labor to keep the wheels moving. Little by little the solicitor can show that electricity driven machinery represents economy of power by means of direct connected units; that motors occupy little space, and may be taken off the floor and stuck on the walls and ceilings; that they cost less than half the price of any other kind of power machinery; that they are clean, noiselses, convenient, and reliable, and do not require skilled labor to operate them. The work of the solicitor may be greatly aided by the company having a show room in which all kinds of electrical appliances, big and little, may be seen and their usefulness and convenience demonstrated. The public may thus become familiar with the workings of the different apparatus, and the solicitor will have an advantageous place to which he may invite prospective consumers, and there explain the actual operation of what he wishes to sell. Too much care and attention cannot be given in the arrangement and fitting up of this room. Lamps of every size and design should be tastefully displayed so as to obtain the best effects out of each. With them there should be shown the current saving devices, and also electric meters in operation. The latter will help to educate the people to be familiar with the meter's mechanism, and tend to inspire confidence. Then there should be specimens of all sorts and varieties of practical appliances which may be used in the house, office, store, and workshop. In short, a continuous exhibition of what may be had in electric apparatus and what may be done with them. In this show room there should always be plenty of small booklets, giving illustrations and concise information regarding the different kinds of appliances, so that those inspecting them may have something to carry away to refresh their memories, and arouse the interest of others.

APPLIANCE SHOW ROOM.

ELECTRIC OFFICE DISPLAY.

But the manager of a central station must show his belief in what he produces and sells by using freely what he wants *others to buy*. He preaches that an electric sign is the best kind of an advertisement. Does his company use one? He advocates a well lighted store and a brilliant window. But how about the company's office? Is there plenty of light, and is it burned far into the night? Has he electric fans, footwarmers, and radiators installed for the benefit of employees and customers? What is the use of his saying that "trade follows the light," if he does not illuminate his own premises. If he has no electric sign over his office, what is the use of his preaching that the same law which draws the moth to the flame of the candle, also draws the buying public to the brilliantly lighted store. Let deeds as well as words show that he has plenty of confidence in his own product.

SYSTEM.

It was Thomas A. Edison who said that "genius is partly inspiration, but mostly perspiration." In other words, energy is what produces results. But much energy may be lost because it is not systematically applied. The manager of a new business department will find that system is a good servant for him to employ. The larger the business transacted, the better must be the system, and that system is best which substitutes knowledge for guess-work, and economize time, labor and money. There must be system in advertising, and system in laying out the work for solicitors. There should be system in noting the results of advertising and the returns which solicitors bring in. There will be inquiries, leads, and prospects, the data concerning which requires to be kept up to date and accessible. There should be system in handling what has to be done, and what has already been accomplished. System in noting sales, terms, proposals and contracts—records of buildings to be constructel, names of owners, contractors and tenants, and the particulars regarding the probable requirements of each. In records of prospective power consumers, complete information is necessary about present installations, kind of machinery, maker's name, horse power, use and hours of operation.

CARE OF CUSTOMERS.

In all branches of the New Business Department's work, system is needed, but not the kind of system which becames a tax and a burden. The longer he is at his work, the longer he is dealing with the people, and the longer he is trying to sell electricity, the more will the new business manager be impressed with the fact that the best advertisement is a pleased customer, and the best possible solicitor is a consumer who is satisfied. All the work of his department is practically wasted if the new business taken on is not properly cared for. It is a regrettable fact that, as a rule, there does not seem to be a proper sympathy between the public and the electric

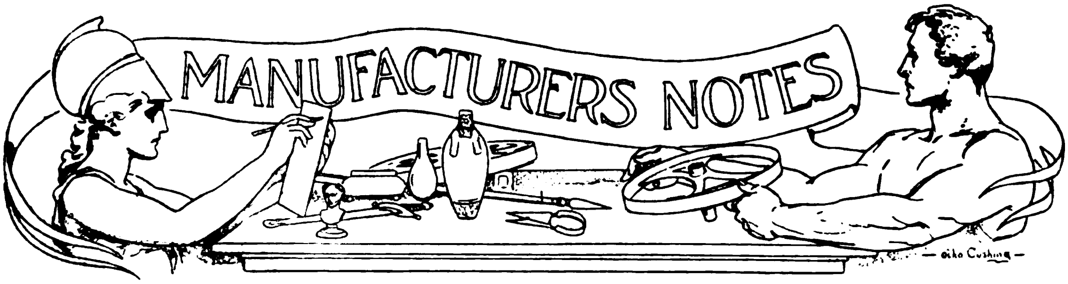
company. They do not seem to understand each other. The public is too liable to think it is being overcharged or imposed upon, and the employees of the company to think the public kicks too much. And the fact is still further to be regretted because the companies are largely responsible for this condition. Employees are not trained to be courteous and polite, to put themselves in the customer's place, and understand why they ask questions about what they do not know, and why they "kick" when those who are taking their money do not give them proper attention and civil answers. The importance of this subject cannot be over-estimated, because it is up to the company to do everything possible to establish and maintain friendly relations with its customers. The New Business Department must be backed by good service, and "good service" only begins with the production of the current. Good service requires that there should be polite and attentive clerks, collectors, meter readers, and trouble men; that complaints shall be listened to and promptly investigated, and the settlement of disputes and adjustment of claims shall not be sidetracked and postponed beyond reason. The very existence of a company depends upon the good will of its customers, and for this reason inattention and discourtesy on the part of any of its employees should be considered unpardonable.

GOOD SERVICE.

The agents of the New Business Department go out after business. They approach a man in his own house or office, and then it is that a man is liable to talk freely of how the company has treated him. If the treatment has been bad, the agent's chances of doing more business are very slim. If the treatment has been good, the chances for more business are excellent. Again it is pointed out that the best means for advertising a business is to be advertised by its friends. If a man is a consumer, look after him. If he has a complain or is in trouble, give his case immediate attention. His general opinion may be that corporations have no souls, but he will find that individuals in the corporations have, and it is by the work of the individuals that he is going to judge your particular corporation. If a man is a power user, he is depnding on that power to help him earn his daily bread. He may have a large number of employees, or he may be operating a motor by himself. In either case, if the power goes off, or some trouble occurs with his service, he is put to inconvenience and expense until the trouble is rectified. As a rule when he has trouble with his motor or service, the first thing he does is to call up the electric company. The first thing the electric company should do in such a case is to give the man's trouble the right of way. Whether the cause of the trouble is the fault of the company or the consumer does not much matter; the fact that the consumer is shut down is sufficient reason to see that he may be running again as quickly as possible. It is this kind of treatment that makes friends for the company. It will be found that one of the most successful ways of convincing prospective power users that the energy you have to sell is the energy they need, is to take them to plants which are being operated by electric power for similar purposes to what they would use it. Then have these consumers who have been using power for sometime tell the prospective customer how electricity works; what are the advantages and troubles (if any) and what is the cost of operation. The prospective customer is liable to think that the agent of the company is prejudiced, and you cannot blame him. Besides, the man who is trying to sell him a steam or gasoline plant has probably told him something just the opposite to what your agent has said. But if he is going to run a machine shop, or a planing mill, or a foundry, or a peanut stand, take him or send him to some of your customers who have been running similar plants with your electric power. And if you have treated your customers right, they will honestly help you to win others—and frequently put themselves out of the way to do it.

RESULTS.

However, result are the best test of all work, and there is nothing problematical about the results to be obtained by a New Business Department if it is operated with Diligence, Intelligence, and Perseverence. Let the department manager cultivate among his assistants a spirit of pride in the work. Let him encourage and enthuse them, so that a healthy emulation may exist: an emulation to excel each other for the benefit of the company's business, and to pull together, so that the successes of to-day may be but the stepping stones for the achievements of to-morrow. Let there be politeness, attention, and courtesy in all ranks and at all times, and under such conditions the central stations will surely prosper and the tiny stream of new business which once had to be coaxed and persuaded, will eventually begin to flow as a river, and continue to grow in force and volume day by day.



Power Machinery Exportations.

The Westinghouse Machine Company, of East Pittsburg, has recently sold to the United States Government for use in connection with the Panama Railroad, two compound steam engines; one direct connected to a 325 k.w., 250 volt engine type generator, and the other to a 200 k.w., 60-cycle A.C. two-phase, 220-volt generator. Both operate under a steam pressure of 150 pounds.

Two 165 B.K.P. producer gas engines are to be installed in the plant of the Calgary Milling Company, at Calgary, Alberta, Canada. The engines operate at an altitude of 3,000 feet, using anthracite coal for fuel, with possibility of a change to natural gas as soon as supply is obtained.

G. & O. Braniff & Company have ordered a 300-kw., Westinghouse-Parsons steam turbo-generator unit. The turbine will operate on 150 pound steam pressure and 27-inch vacuum, and will be installed in the plant of S. Roberts & Co., Mexico City, Mexico, generating 50 cycle current at 6,000 alternations.

The Rio Janeiro Tramway, Light & Power Company will install at Rio Janeiro, Brazil, a 300-kw. Westinghouse compound engine unit operating under a steam pressure of 150 pounds and direct connected to a Westinghouse A. C. generator.

40,000 Horse Power in Allis-Chalmers Hydraulic Turbines for Duluth.

The plans of the Great Northern Power Company of Duluth, Minn., for the development of water-power in the Northwest are second only in scope to those so successfully carried out at Niagara; and when they are brought to full completion will provide for the transmission of 200,000 horse-power to an ever-widening circle of users. The power plant, which is now under construction, will have an initial equipment for the generation of 40,000 horse-power, with an ultimate capacity in this one station of 80,000 horse-power. It is located three miles from the city limits of Duluth, on the St. Louis river, the distance for transmission to the distributing center being 14 miles, to the cities of Duluth and Superior, where substation equipment will be provided. From the strategic position of the generating stations, the future possibilities of the development may readily be surmised. The Mesabi and Vermillion Iron Ranges, in which the greatest iron mines of the world are located, lie from fifty to seventy-five miles to the northward of the plant, and are destined eventually to be operated from it. Along the Southern shore of the lake to the westward and within transmission distance are the Gogebic Crystal Falls and Gogebic iron ranges and the copper mines of the Calumet district. The railway and lighting interests of Duluth and Superior have already contracted for electricity from the new source, and the long harbor frontage of docks and warehouses offers great opportunities for the use of electric hoists, lamps, etc. The transfer of freight at the head of the lake between steamship and railroads reaches an enormous figure. For the year 1905, the tonnage entering Duluth, Superior and Twin Harbor amounted to 25,000,000 tons, or more than that from the port of New York.

The distance from the head gates to the power house is 2.8 miles, about 2 miles of which is canal and forebay. Over the remaining distance the water is carried through about 3,800 feet of wood stave pipe and about 1,000 feet of 7-foot steel pipe for each water-wheel unit. The difference in elevation between forebay and power house is 378 feet. The building, which for the present will be 181.5 feet long and 77 feet wide, will be constructed of brick masonry with framing. The initial hydraulic ap-

paratus consists of three turbine water-wheel units, each designed for a capacity of 13,000 horse-power. They will operate at a speed of 375 r. p. m., from a fall of 389 feet. The wheels are furnished by the Allis-Chalmers Company of Milwaukee and are of the single vertical Francis type. The exciter outfit will comprise two single vertical impulse exciter wheels, each one developing 350 h.p. at 500 r. p. m. from a 336 ft. head. The general scheme of the Great Northern development was originated by Mr. T. A. Cokefair, of Duluth, and was executed by the National Contracting Company under Mr. Cokefair's direction as chief engineer.

H.C.K. Instantaneous Electric Water Heater

After considerable experimenting, and many tests conducted during the past year, the H. C. K. Company has produced a new form of electric heater for heating water instantaneously.

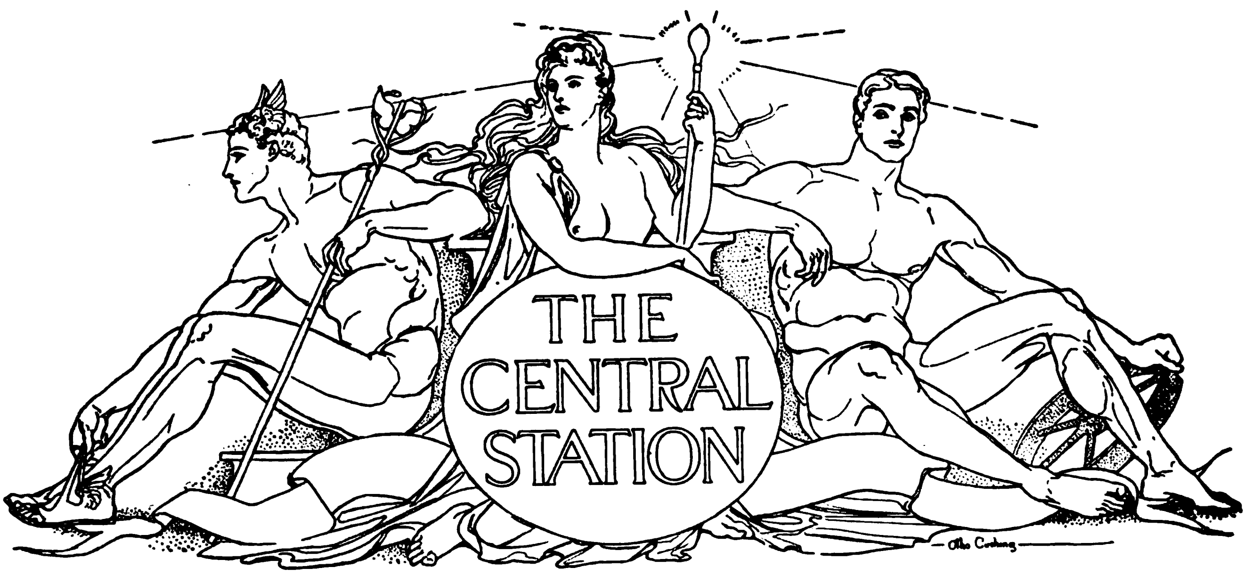
H.C.K. INSTANTANEOUS ELECTRIC WATER HEATER.

It was found during the tests that it would be impossible to heat water instantaneously by any other method than direct contact between the water and the heating element. This form of heater was then developed, but while the efficiency could be maintained extremely high and the heating of the water could be made as rapid as desirable, the life of the heating depended altogether upon the presence of the water. The problem was solved when an automatic cut-out was applied to the electric water heater which would interrupt the current when the water ceased to flow, or if the flow should be reduced to such an extent that the water in the heater would boil.

At first sight, it might appear that the water flowing through the heater around the heating coil would introduce a ground on the electric system. This is however not the case, as insulating joints are provided at top and bottom of the heater tube and the resistance of the water is sufficiently great to prevent any flow of current. Where the heater is connected to the regular Edison three-wire systems, the neutral, or grounded connection, is connected to the lower part of the heater, which absolutely prevents any grounds, as there can be no difference of potential. This is also the case where the heater is used on alternating systems where one side of the neutral of the secondary circuit is grounded.

The H.C.K. Instantaneous Electric Water Heater consists in the main of a supporting box, upon which is mounted a double pole quick break switch, an insulating joint of special design to the lower end of which is attached a ¼-inch water valve. Screwed into the upper part of the insulating joint is a bronze fitting within which is placed the cut-out which automatically opens and closes the electric circuit as the water is turned off and on.

Edge Moor Iron Company, of Edge Moor, Del., manufacturers of the Edge Moor water-tube boilers, have just gotten out a most attractive one hundred page catalog describing and illustrating, by means of half-tones and line cuts, the construction of their boilers in every detail. The catalog at the same time gives many illustrations of the interiors of electric lighting and power stations and their plants, showing these boilers, many of which are the most representative electric lighting and power stations in this country. The book is bound in red cloth, and is a most comprehensive treatise on the subject, and will be mailed to any reader of THE CENTRAL STATION upon request.



DEVOTED EXCLUSIVELY TO THE INTERESTS OF ELECTRIC LIGHTING AND POWER STATIONS.

VOL. 6, No. 4 | NEW YORK, OCTOBER, 1906 | ISSUED MONTHLY.

Central Station Light, Heat and Power Principles.

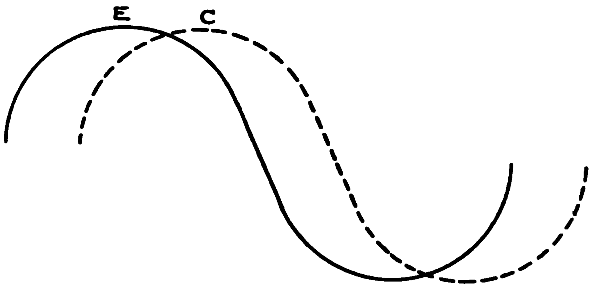
BY NEWTON HARRISON.

Effects of Frequency.—The effect of high or low frequency upon the capacity of a line to conduct a given amount of energy has led to the adoption of as low a frequency as is consistent with a continuity of flow. It is also evident that the question of resistance is secondary in circuits carrying a current of high frequency. The inductive resistance is the limiting influence in all cases where a high frequency is employed. The frequency is generally from 50 to 120 cycles per second in electric lighting. The effect of increasing the frequency is to make the copper conductor become inoperative. The cross section of the conductor is not permeated by the electrical energy. It passes along the outer surface more and more as the frequency is increased, until at very high frequencies a thick copper bar becomes absolutely nonconductive to that particular form of energy. Low frequencies in power transmission plants are necessary features if conductivity and efficiency are important considerations. The effects of the static capacity of the line and its inductance increase with the frequency. The sketches, Fig. 1 and Fig. 2, show how the current and pressure become separated by the effects of induction and frequency. The development of a form of energy which is ineffective or *wattless* is readily discovered when the above conditions are exaggerated.

The Synchronous and Induction Motor.—The alternating current in its simple form, single pnases as it is called, will not start an alternator to be used as a motor, from a condition of rest, unless it possesses the same number of poles and is speeded up until it is in step with the alternator. The motor and alternator are then said to be in synchronism, but, as has been stated, to rise to synchronism, the alternator serving as a motor must be speeded up. Devices have been employed to serve this purpose, consisting of either means to split the phase, and thus develop temporarily the effects of a two-phase current, or to use a commutator and series winding, Fig. 3, on the armature and field, respectively.

In this latter case, the alternating current serves to operate a series motor through the medium of the commutator and winding; then when the requisite speed is secured the alternator is employed entirely as a synchronous motor.

The induction motor, Figs. 4, 5 and 6, operated by a two or three phase current, is self-starting. It consists of a field so constructed that the two or three phase current creates within it all the effects of a rotating wave of magnetism. A laminated iron armature, around whose periphery are set copper bars parallel to the shaft, will start itself from a condition of rest when exposed to the influence of the rotating field. The series wound motor has recently risen to prominence as serviceable for railroad purposes in connection with single phase alternating currents.



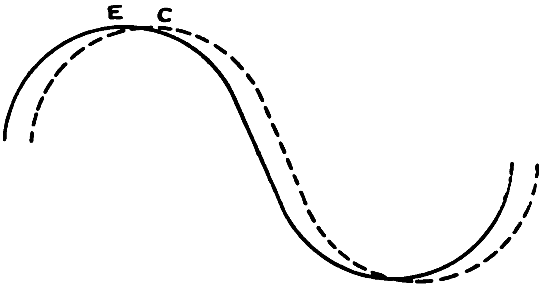


FIG. 1.—EFFECT OF HIGH FREQUENCY AND INDUCTION SEPARATING C AND E.
FIG. 2.—LOW FREQUENCY, CAUSING A BETTER CO-OPERATION OF C AND E.

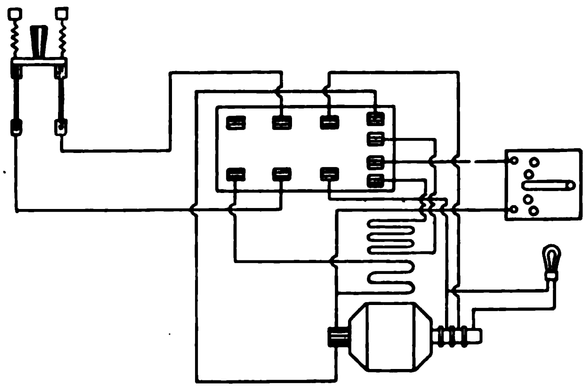


FIG. 3.—SYNCHRONOUS MOTOR. MADE TO BE SELF-STARTING BY COMMUTATOR AND SERIES FIELD WINDING.

Their construction on a large scale will have a great influence on power transmission plants in that they remove the necessity for the conversion of the power into a direct current. It can be transformed down to a pressure suitable for railroad service and need not be generated as other than a single phase current. Experiments performed in this direction give great promise of future usefulness. The series wound motor employed for this purpose is constructed in all essentials like a direct current machine, but particular attention is paid to the induction. This is regulated by the design to meet the conditions of practice.

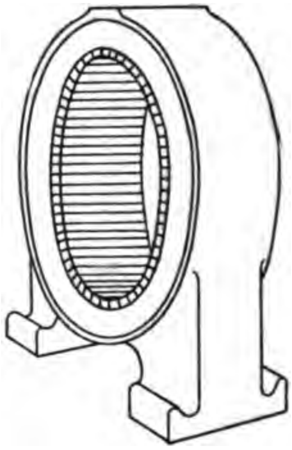


FIG. 4.—PRIMARY READY FOR WINDING.

Effects of Inductance.—The general effects of inductance are such that impedance is manifested primarily, the consequence of which are a limitation in capacity of the circuit for the conveyance of power. The idea is well exemplified in the case of a choke coil connected to a lighting circuit. The choking effect becomes more and more magnified as the inductance in the coil is allowed to increase. The increase in induction causes a greater and greater separation between the two elements of power, namely, the volts and amperes. The diminution in power as this difference is augmented, brings clearly

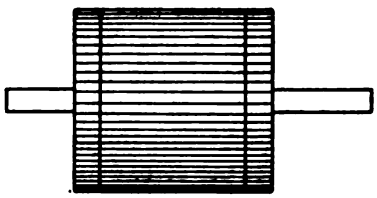


FIG. 5.—SECONDARY COMPLETE.

to view the meaning of the power percentage factor or power factor. The apparent power and available power, when compared as a ratio, show the contraction of the line electrically. In great power lines this fact is a controlling influence in their calculation and operation. Frequency and inductance may be considered as the modifying elements in power transmission by alternating currents.

Varying the Power Factor.—The variation of this factor is shown by changes in the relationship between the E. M. F. and current. These variations are due to the difference in phase between one and the other. If it is supposed that the E. M. F. and current represent the sides of an angle, then the more nearly the sides coincide, the less is the difference between the apparent and real power available. The more widely they diverge, the less actual energy is at hand. The angle is called ϕ according to the general notation and in a mathematical way the

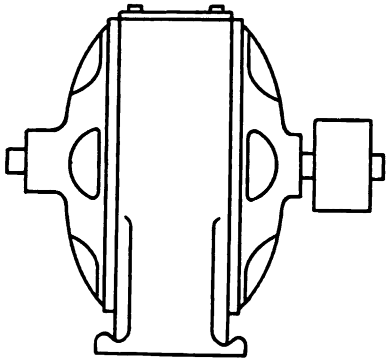


FIG. 6.—MOTOR COMPLETE.

expression reads—the watts are equal to E x C cos ϕ, where the relationship between E and C as affected by the frequency, capacity and induction is shown by the cosine of the angle.

The Wattmeter.—The power measurement cannot be made by an alternating ammeter and voltmeter for the obvious reason that these instruments take no cognizance of the difference of phase. The wattmeter, however, is contrived to meet this requirement and gives readings of the true watts. The diagram showing how this purpose is attained is given in Fig. 7. There is shown a movable coil and a fixed coil. The movable coil is placed as a shunt across the terminals, Fig. 7, when the meter is used. It has in series with it a non-inductive resistance. The fixed coil is placed in series with the circuit. Under these conditions the instrument has two currents operating in such a manner that the force required to hold the movable circuit with its axis at right angle to that of the fixed coil, will be proportional to the product of the mean value of the currents, respectively. In other words, the wattmeter gives the net results of the power in the circuit. The conditions of success as given by Prof. Fleming for the operation of a wattmeter are covered by the following statement: "The current through the series coil of the instrument must have

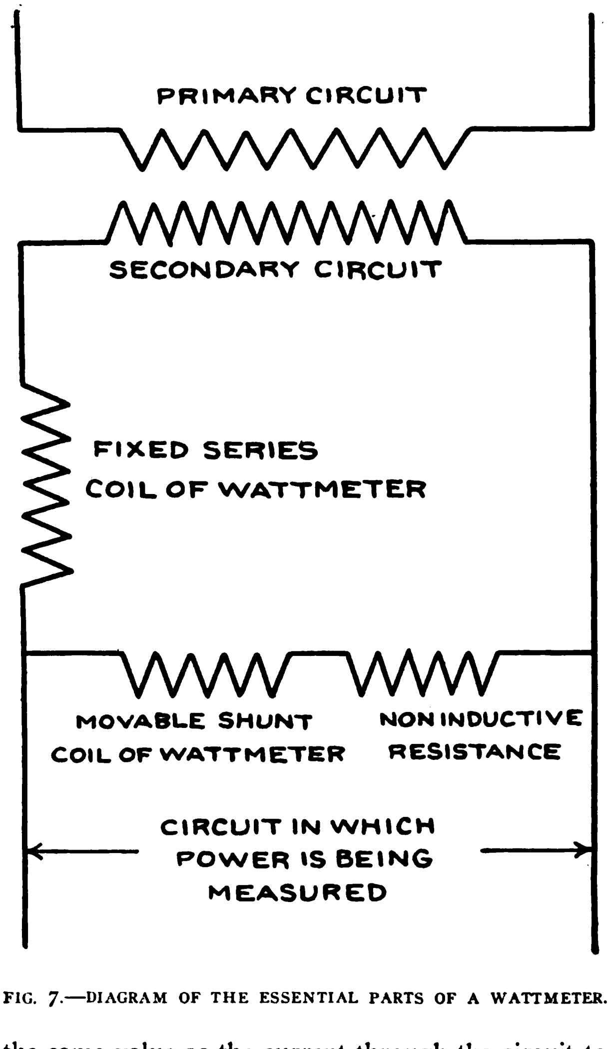


FIG. 7.—DIAGRAM OF THE ESSENTIAL PARTS OF A WATTMETER.

the same value as the current through the circuit to be measured; and the current through the shunt coil of the wattmeter must be exactly in step with the difference of potential between the ends of that shunt circuit; in other words, the shunt circuit must be strictly non-inductive. This can only be secured by winding the movable coil of the wattmeter with no very large number of turns. It is convenient to

call the product the root-mean-square value of the amperes, and the root-mean-square value of the volts, the *apparent* watts taken up by the circuit; and to call the true mean value of the power as read by the wattmeter the *true watts* taken up by the circuit."

Reduction of Watts with Greater Angle.—To show a simple case or two of the influence of lag on the part of the current, take an instance of 100 volts no difference of space, the two power components and 10 amperes operating in the circuit. If there is operate simultaneously, and the total energy $= 10 \times 100 \times$ cos O° $= 1) = 1{,}000$ watts. If inductance causes a lag of 10°, then the total watts $= 10 \times 100 \times (\cos 10° = .985) = 985$. If the inductance causes a further increase in lag, until it reaches a value equal to 30°, the true watts are $10 \times 100 \times (\cos 30° = .866) = 866$ watts. The power factors in these cases are respectively the ratios between the true watts and apparent watts or $1{,}000 \div 1{,}000$, $985 \div 1{,}000$ and $866 \div 1{,}000$. The figures are, therefore, 1.00, .095 and .866 in all. The power apparent with ammeter and voltmeter would be 1,000 watts, because of no attention being paid to the angle of lag.

Alternating Current Rotaries for Polyphase Circuits.—The transmission of electrical energy over great distances, has developed with the increasing perfection and adaptability of the rotary converter. A power station, situated at a distant point, may by its means distribute its power and with relatively great economy over an area beyond vision from its site.

Certain standard voltages and frequencies are employed and embrace figures as follows: Alternations, 3,000, 3,600 and 7,200 per minute, corresponding to voltages of 125, 250 and 550 volts as required. The standard Westinghouse two-phase rotaries, according to their bulletin, receive at their collector rings about .7 of the pressure given out at the commutator as a direct current. With a three-phase rotary at the collector rings, the ratio is about .6 of that given out at the commutator end.

A two-phase 220-volt rotary can be so connected that with respect to the transformers supplying the power, 110 volts can be readily obtained for electric lighting on the three-wire plan. Sparking is almost entirely absent from this class of machines and changes in speed are in strict proportion to the frequency of the current from the central station. The result of variations in frequency causes "hunting" or pulsatory movement due to more rapid changes in frequency than can be responded to by the rotary.

Starting a Rotary.—If a rotary is connected directly with the supply circuit, it will take a very

Table of the Cosines of all Angles from 0 to 90 Degrees for Calculating Power Factors.

Angle	Cosine	Angle	Cosine	Angle	Cosine	Angle	Cosine	Angle	Cosine	Angle	Cosine
0	1.000	16	.961	32	.848	48	.699	64	.438	80	.174
1	.999	17	.956	33	.838	49	.656	65	.422	81	.156
2	.999	18	.951	34	.829	50	.643	66	.407	82	.139
3	.998	19	.945	35	.819	51	.629	67	.391	83	.122
4	.997	20	.940	36	.809	52	.616	68	.374	84	.105
5	.996	21	.934	37	.798	53	.602	69	.358	85	.087
6	.995	22	.927	38	.788	54	.588	70	.342	86	.070
7	.992	23	.920	39	.777	55	.574	71	.326	87	.052
8	.990	24	.913	40	.766	56	.559	72	.309	88	.035
9	.988	25	.906	41	.754	57	.545	73	.292	89	.017
10	.985	26	.899	42	.743	58	.530	74	.276	90	.000
11	.982	27	.891	43	.731	59	.515	75	.259		
12	.978	28	.883	44	.719	60	.500	76	.242		
13	.974	29	.875	45	.707	61	.484	77	.225		
14	.970	30	.866	46	.695	62	.469	78	.208		
15	.966	31	.857	47	.682	63	.454	79	.191		

heavy current with a very low power factor. It can be started by getting it up to speed by using a direct current and then switching in the other circuit.

Another way is to use a small induction motor to raise the speed. Tabulating the results gives the following:

First. Starting a rotary by connecting to the alternating current circuit.

Second. Starting a rotary by connecting to the direct current circuit.

Third. Starting a rotary by driving with an induction motor.

Rotaries may be employed for delivering an alternating current instead of a direct. They receive direct and give out alternating for special purposes. Standard sizes are constructed for frequencies of 25, 30 and 60 cycles, equal to 3,000, 3,600 and 7,200 alternations per minute. The voltages preserved in practise, as shown in stations, are 250 and 550 volts.

Prepared for THE CENTRAL STATION by Colin P. Campbell, Attorney.

Enjoining Injury to Shade Trees by Wire Lines.

A late case about the matter of pole rights and interference with shade trees, is that of Osborne v. Auburn Telephone Company, 97 New York. Sup., 874; and, although a telephone company was involved, the principle is equally applicable to power companies desiring to set poles and string wires in highways and, therefore, we use the opinion.

The evidence showed plaintiff to be the owner of a large tract of land in the city of Auburn, New York, fronting on South street, and also lying north of and abutting on Fitch avenue, a street running westerly from and with right angles with South street. The defendant was a telephone company with a franchise, permitting it to use the streets of the city, including Fitch street, for the placing of poles and stringing of wires. The franchise imposed upon the defendant certain restrictions antecedent to the user, which have been substantially complied with, and where disregarded, they are in the review of this appeal. In the spring of 1904 the defendant was engaged in erecting poles and stringing wires along the north side of Fitch avenue adjacent to the premises of plaintiff. The plaintiff has a row of shade trees along the north side of this avenue which were planted by the plaintiff and her husband over 30 years ago, and which had attained considerable size and were an ornament to her premises. The defendant dug holes for its poles and the earth removed was afterward replaced by the employees of the plaintiff and was again taken out and the poles erected, when they were cut down under the direction of the plaintiff. This action was thereupon commenced to restrain the defendant from erecting its poles, and a temporary injunction was granted enjoining the defendant from digging on the north side of said avenue in front of the premises of plaintiff, or from erecting poles or stringing wires along said land. The plaintiff gave proof tending to show that large limbs on a number of the shade trees were cut off, rendering them unsightly. The defendant gave proof tending to show that only three limbs of any size were cut, and that the plaintiff was present and consented to their removal. The court found that the defendant "trimmed certain limbs of the shade trees," but "that said trimming was in part authorized by and consented to by plaintiff." No proof of specific damages appears in the record, and

the court directed the dismissal of the complaint on the merits, "but without prejudice to an action for damages by the plaintiff."

The Court said: "The defendant derived the right to the use of the streets from the Legislature, subject to the reasonable control and regulation by the municipal authorities. It was therefore lawfully in the street, and not subject to the plaintiff's interference simply because in the necessary development of its business it happened to erect poles contiguous to her premises. This right to the use of the street, however, is entirely independent of the question of the plaintiff's claim to compensation for any damages which may have resulted to her property by the construction of defendant's line. There has been much discussion of this subject by the courts and no clear, well-defined rule seems to have been reached."

In Eels v. American Telephone & Telegraph Company, 143 N. Y., 133; 38 N.E., 202, 25 L. R. A., 640, the plaintiff owned a farm, his title extending to the center of the highway. The defendant erected his poles along the road in front of these premises without having compensated the plaintiff or commenced proceedings for condemnation of the land. A recovery by the plaintiff was had in an action of ejectment, and the judgment was sustained by a Court of Appeals. The court was particular to place its decision on the ground that the highway was in a country community and pointedly disclaimed any purpose to extending it to a street in a city. The distinction between this rural and urban use of the streets is also recognized in Palmer v. Larchmont Electric Co., 158 N. Y., 231; 52 N. E., 1092, and in Dillon's Municipal Corporation, 688. In Castle v. Bell Telephone Co., 49 App. Div., 437, 63 N. Y. Supp., 482, the common council of the city of Rochester authorized the defendant to place its wires beneath the surface of Oxford street in that city. The plaintiff owned premises fronting on the street, extending to the center, and commenced an action to restrain the defendant from tearing up the street and locating the wires as directed by the municipal authorities. This court held that the use of the street contemplated did not impose any additional burden upon it, and the abutting owner was not entitled to compensation. The principal was again reiterated, in a measure at least, in Johnson v. New York and Pennsylvania Telephone & Telegraph Co., 76 App. Div., 564, 78 N. Y. Supp., 598. We find no case holding that compensation will not be awarded the owner where a telephone company in the prosecution of its business mutilates the trees of an abutting owner to such an extent as substantially to lessen the value of the premises.

The complaint in the present action alleges that the defendant "wrongfully, wilfully and wantonly and without authority" trimmed and destroyed her shade trees to the damage of $1,000. It then contains allegations impugning the right of the defendant to place poles in the streets, and asks that it be enjoined permanently from carrying on its work. The plaintiff was content to prove the trimming of the trees, without giving any proof showing to what particular extent any tree was damaged or whether the premises were depreciated in value by cutting the trees; and the question of damages was left to another action at the election of the plaintiff. If these trees were trimmed "wantonly and wilfully," the defendant would be liable, independent of the question of its rights, to use the street without the payment of compensation to the abutting owner. The privilege permitted implies the ordinary use for the furtherance of the work within the purpose of the charter of the transportation corporation. If, in the exercise of that power, the corporation is negligent or wanton in the execution of its business to the detriment of a contiguous owner, it must pay the penalty of its rashness. In Donahue v. Keystone Gas Company, 181 N. Y., 313; 73 N. E. 1108, the plaintiff owned a lot fronting on Union street in the city of Olean, but not extending to its center. The defendant was a corporation using the street rightfully in the distribution of natural gas to the inhabitants of the city for heating and lighting, and its pipes were underneath the surface of the street. In front of plaintiff's premises were a number of large maple trees. The defendant allowed the gas to escape from its pipes into the soil and about the roots of these trees, causing their destruction. The plaintiff recovered the damages sustained by the loss of the trees, and the judgment was affirmed. The right of the defendant to use the streets was unquestioned, but the manner of the use was the subject litigated and liability followed by reason of negligence. If, in the present case, the plaintiff had elicited tangible proof so that the trial court might have measured the damages, it might have ascertained them. As the record is presented to us, there is nothing to indicate that the plaintiff did not regard the damages as nominal.

The real controversy tried before the court apparently was the right of the plaintiff to place its poles upon the north side of this avenue. The damage to the trees had already been committed, and the plaintiff insisted, irrespective of any question of compensating her therefor, that the defendant was guilty of trespass in erecting its poles in the street. As already indicated the plaintiff did show the cutting of the trees, and the defendant, if its witnesses are to be believed, especially that but a few limbs were trimmed, and they were removed with the consent of the plaintiff. The finding of the court does not definitely cover this controverted question of fact. We may assume that the court adopted this course for the reason that the extent of the damages was not given, or because he may have concluded that they were unsubstantial. In any event he afforded the plaintiff another opportunity to establish them, if she desired to do so.

It is unimportant, as we view the case, whether plaintiff's title included one-half of Fitch avenue or was limited to its northerly boundary. She had planted and nurtured the trees, and the city had acquiesced in her ownership of them; and her title is sufficient to enable her to recover damages, if she is otherwise entitled to relief.

The judgment should be affirmed in this case, with costs.

Judgment affirmed, with costs. All concur.

Construction of Franchise.

It is also very important to know what rights the company had under its franchise. What construction should be put upon it, what effect it may have upon other franchises and what effect other franchises may have upon it. It is generally the rule that a franchise shall be subjected to a strict construction. That is to say, when a phrase in the franchise or grant is equally susceptible of two constructions, that construction shall be adopted which shall be least beneficial to the company. Pursuant to this rule it was held in Cook v. North Bergen Tp. (N. J. L.) 59 Atl. Rep., 1025, that where the franchise permitted the erection of poles and stringing of wires the company would not be entitled to lay the wires in conduits or excavate the street for such purpose, without further permission from the municipality.

The principle upon which a strict construction is pursued against the owner of a franchise is the rule that all grants by the State cannot be construed as conferring powers in excess of those actually granted by the language used. Therefore, if there exists any doubt as to the intention of the legislature or governing body in the words which it is claimed conferred powers or franchises that doubt must be resolved against the company claiming the right and in favor of the State. The words of a grant cannot be extended beyond a strict import of the language used.

Under this branch of our subject may also properly be considered the question of rights conferred by franchises in particular instances. Thus, it has been held that two franchisees may use the same line of poles. That is, one company having erected the poles may permit another company to use them.

Bergen v. South England Tel. Co., 70 Ky., 54, 38 Atl., 888.

However, if a franchise is granted to a street railway company for the purpose of occupying the streets and operating a street railway, its franchise to erect poles and string wires may not be disconnected from the operation of a railroad and its grant will not permit it to erect poles and string wires merely for the purpose of carrying a current for electric lighting.

Carthage v. Carthage Light Co., 97 Mo. App., 20; 70 S. W. Rep., 936.

It is ruled by the same authority that a transfer of the franchise right to another company is not permissible if the purpose of the transfer is to permit the other company to operate for a different purpose than that permitted to the first company.

CONFLICTING FRANCHISES AND GRANTS.

Grants of rights to electric lighting and power companies must of necessity frequently confer powers which will seem at least to conflict with the powers previously conferred upon other companies. Especially is this true where electric railway companies, gas companies, telephone and telegraph companies, water companies, have previous rights in streets claimed by electric lighting companies for their subways, conduits, poles or wires. The almost universal rule which applies to situations of this kind is the old maxim of the Roman law: *Priorie es in tempore potior est in jure*—he who is prior in time is first in right. Thus, as between electric light companies exercising similar franchise upon the same

street, priority carries superiority of right. Equity will equalize the conflicting interests as far as possible, and control both so that each company may exercise its own franchise as fully as is compatible with the necessary exercise of the others. But if interference and limitations of one or the other are unavoidable, the latter must give way and the fact that it is under a contract with the city for work of a public nature, as to light the public streets of the city, does not alter the position of the company acting under the later franchise or give it any claim to preference. Consequently, upon a bill filed by the prior franchise, equity will enjoin acts by a later company against its rights and also all interference which is not publicly unavoidable, as the matter of keeping wires of the prior company free from interference by the wires of the later franchisee. This case is a late one, having been decided in the present century, the opinion is well considered and the authority is valuable as crystalizing the law upon this point.

Edison Electric Light & Power Co., v. Merchants and Mfg. Electric Light Co., 200 Pa. St., 209, 49 Atl. 766.

The principle of priority in time does not confer exclusive privileges, and depends more for its application upon a prior occupation than it does upon the enjoyment of a prior franchise. Thus, in the Nebraska Telephone Co. v. York Electric Light Co., in which it was shown that the electric light company first secured a franchise, began the construction of its line, determined upon what streets it would occupy and notified the telephone company of that fact, an injunction was held to be improper on the behalf of the telephone company restraining the electric light company from occupying the streets. The principle being that the electric light company had first occupied the streets. Neither will an injunction pass in the same suit against a telephone company to restrain it from placing its wires near the wires of the electric light company, when it was shown that said wires will not interfere with the electric light wires.

Likewise, a subsequent franchisee cannot complain and obtain an injunction against a public officer to prevent him from interfering with the erection of its poles, without a legal permit for such erection, on the ground that such permit was refused unfairly and in a spirit of discrimination against it and in favor of a rival company.

Mutual Electric Light Co. v. Ashworth, 118 Cal. 1.

A company claiming an exclusive franchise, to furnish light to a city may restrain another company from setting up such exclusive right and thereby casting a cloud upon the title of the first company, even though the first company is not in possession of the street.

People Electric Light & Power Co. v. Capital Electric Power & Light Co., 75 (Ky.) S. W. Rep.

Electric Heating and the Residence Customer.

By James I. Ayer.

The subject of Electric Heating, attracting as it is so much consideration to-day, offers little that is new to present to this audience in the way of additional development on the line of new appliances or new applications. This is not surprising when the past is considered, but how few realize the past of this industry, is only appreciated by those who have been identified with its creation for a considerable period.

The first few years of development caused every possible application to be investigated, resulting in great variety of articles of common use requiring heat being arranged for electric heat—many of which are catalogued, and many being set aside as being in advance of the times but which will later on be found practical.

At former meetings you have had papers setting forth the advantages of electric heating which told the story of its usefulness, and to-day there is but little more to be said without going over the same ground, but because of the greatly increased interest in the subject it seems desirable.

That there is an important almost untouched field for electric heating is now broadly recognized. How

important it is and how advantageous to develop, is, I think, but little understood. Its character makes it largely a day load, and while it is of much value in its application in business establishments and factories, its most important field to the central station is with the residence customer.

The residence customer to-day pays the highest rate. To reduce this rate is most essential, for nothing goes further to check popular prejudice than personal consideration of the individual, and a reduction of rates to residence customers reaches a man in his home. Electric lights are used in the average dwelling because of their convenience and other well-known virtues partly, but largely to "be up to date." It costs money to be up to date in most things, and if it costs a good deal more for the new than the old, we kick. If it happens that a public service corporation is supplying the new, they have a common enemy to kick, hence much of the trouble you are all familiar with. The residence customer demands the service but cannot appreciate that it is the most expensive you give, and if you explain, he thinks you should find a way to cheapen it, or average your costs and reduce his rates. Human nature doesn't believe in paying "something for nothing," and your minimum charge bill to him is paying "something for nothing." He does not understand that the transformer loss goes merrily on at your expense, though he uses no light, at the rate of four or five dollars per year, and involves additional charges of nearly as much more, all directly created for his service, which would end if his service was discontinued. These facts have no influence with him. He only knows the cost of his service is high by comparison with other, though less satisfactory, methods.

This situation, I think, is fully realized, and it is of vital importance at this time, with the public interest so much centered on corporations that every means at your command be put forth to put you in closer touch with your customers and thereby let them realize that your corporation is a business enterprise managed by their neighbors, on the same general lines as all other honest, progressive business concerns in the community.

Electric heating offers an opportunity to quickly get in closer relation with more people in an effective way than any other means at your command, and if this be taken advantage of to the limit, more will be done to give the people a proper point of view on public ownership than volumes of statistics. By proper effort and systematic work persistently carried out continuously you can secure the introduction of electric heating devices in every home you serve.

The methods that may be used are numerous and from experience we can with confidence make some definite statements.

The advertising methods are numerous in the way of using printers' ink, and much valuable and effective work is being done in this line, and it is understood that no effort to extend any business can have any measure of success without its liberal use. The space devoted to methods of advertising in the electrical press gives convincing evidence of an extraordinary interest in, and an exposition of what is being done.

With an appreciation of the situation it is with some diffidence that I presume to outline a general plan for the average station so far as it relates to a method of extending the use of electric heating and other household devices using electricity.

It has been well settled that more goods of any kind can be sold by personal presentation, and this is, in my opinion, the only way to get the largest return and at the least cost. In all cases it is the only way to get the best results.

For the solicitors, use a customers' list for meter-readers' routes, and make a card catalog divided into sections, and have circulars, or a type-written letter with circulars, set a few days in advance announcing his proposed call and explaining the object.

On each card a record can be kept which will be permanently valuable as it will show when and what articles have been placed, to guide you in future efforts.

It is necessary to send out articles and leave them for trial after explaining fully how to put them in operation, and how they should be cared for, as well as to leave complete printed instructions which manufacturers usually send with each article.

The period of time an article should be left will be governed somewhat by the character of the device, but such an article as a flat iron had better be left thirty days that ample opportunity be given to fully appreciate it. In the first instance of offering electric heaters it is better to allow enough time for trial to insure their thoroughly testing it, and to note if any, the effect of its use on their bill.

The customer should be preferably called on at the expiration of a trial period to learn their conclu-

sions. This is better than leaving or sending them a blank to sign, requesting you to send for the article or send a bill as the case may be, because it is frequently the case that further interest has been developed, and other articles are wanted.

If your office is centrally located on the ground floor, and of course it should be, you should have arranged on shelves behind glass, and in the show window, protected in the same manner, an assortment of samples and a few of the popular small articles as stock, so that if a customer is interested he can be supplied at once.

For newspaper advertising, small advertisements frequently changed but constantly maintained, are to be preferred, rather than occasional large ones, and newspaper advertising is desirable though not to be substituted for the solicitor.

For more extended methods in advertising by circulars or otherwise with printers' ink, we will not pretend to guide you.

Exhibitions at food fairs and similar entertainments always prove to be leading attractions and in that way do advertising, but direct results are usually few, and indirect results are difficult to estimate; considering the expense and attention required, it would seem better generally to seek other methods.

If it can be arranged, undoubtedly it is a good practice to invite your customers to a practical demonstration of the usefulness of electric heating and serve a light lunch, part or all of which would be cooked by the demonstrator.

The universal use of smoothing irons for many demands outside of the laundry makes this an ideal article for first introducing electric heaters. The success which has followed systematic efforts with this article is too well known to need further argument for its selection for such purposes. Thousands are used about the house, other than for laundry work, and for such purposes the cost of operation is but a trifle.

For laundry use they are required from three to five hours per week, costing from fifteen to, at most, fifty cents per week; the latter being for the longest period at a twenty-cent rate. It is fair to say that at the average rate the average family ironing can be done at from one dollar to one dollar and twenty-five cents per month. With such results your customers will use laundry irons. If they do, they will not kick on minimum charge bills because they will appreciate they get something for their money.

Because of the quick appreciation of an electric iron you will be called on for other appliances, and by carefully keeping up your card index your solicitor can be kept busy as the demands from some will suggest what to push with others.

Using the flat iron as an opening wedge you will do well to follow with circulars or folders describing such articles as water cups which will furnish a pint of boiling water in seven or eight minutes in the smaller size, or a quart in a larger size in ten minutes. Either will supply enough for a cup of tea in three or four minutes, and for shaving in less time. These articles are invaluable in the sick room, and for use in hundreds of ways. Improvements in these devices prevent their burning out or overheating in the event of boiling dry. This result is obtained by the circuit being broken automatically if the temperature rises a few degrees above the boiling point.

An electric heating pad can always be placed in a home where there is use for a hot water bottle. Its superior merit is immediately appreciated on the briefest investigation. Aside from its usefulness in illness, it is much used by the aged as a foot-warmer. A naval officer told me he had many nights walked the bridge with a pad under his coat, comfortable in bitter weather, in spite of side remarks about "a monkey on a string."

The nursery milk warmer performs its work by electricity more uniformly and perfectly than is possible with any other method and in a shorter time. An important feature is that the time required to heat it throughout to an even temperature is less than three minutes, making the period so short after the demand is made that peace is certain. Its operation and sanitary character produce universal commendation from physicians. These devices are furnished with a socket plug arranged to receive the lamp which it displaces in the fixture, that is lighted when current is on the milk warmer.

Electric curling iron heaters are welcomed in many homes.

For light cooking and the dining room there are many useful articles.

The chafing dish has many accomplishments to its credit. It can perform nearly all the operations of cooking required in homes, but of course in some cases not on the same scale as to quantity, and only

one operation at a time, yet its possibilities are limitless when electrically heated. It can bake, boil, fry, stew and toast; is under perfect control, and always performs the same under like conditions, because its heat supply is a know quantity. It is a simple matter to cook and serve a good American breakfast for three, of a cooked cereal, eggs poached, boiled, fried, or scrambled, with toast, in thirty minutes with a chafing dish at the cost of 250 watts, and coffee can be made for 100 watts more; a total of from three to four cents at the average residence rates. The stove which operates the chafing dish makes with a kettle a most desirable combination for the tea-table, and with a coffee percolator in place of the kettle, meets the requirements of the breakfast table.

Chafing dishes, tea-kettles, and coffee urns can be had with heaters attached or separate in a variety of grades and designs, and there is no other method so safe, simple or as cheap for performing similar service in the dining room. The cost for current for performing any single operation with any of these devices is more often one cent or less than more, and never exceeds three or four cents.

For equally useful devices performing much the same work and more, in the dining-room or kitchen, we must remember the water cups previously mentioned come in as a part of the list, because they can be used for making coffee or tea, or boiling of any sort. In one case I know of they are used for cooking French-fried potatoes. This type of heater is also made to form a combination of double boiler or cereal cooker, egg boiler, steamer, as well as a plain boiler.

Disc heaters, or stoves with utensils, such as sauce pans, tea-kettles, coffee pots, cereal cookers, vegetable boilers, and the like enable the housewife with say two stoves and two or three utensils to do all the necessary cooking for light meals, in the dining-room if she pleases, within the limits of cost previously mentioned.

Realizing these facts, you must know that it only remains for your customers to know that they can do this to broadly extend their use. I have on several occasions made similar statements before and some of you have profited by them, but many have not. Some say they are drawbacks; that you have tried electric heaters and they are too slow; that you cannot boil a pan of water in half a day, etc. To such, it did not occur to them that a 200 watt stove was hardly the proper size for a one gallon open pan.

Within a week I received a complaint that a stove purchased was worthless because it would not heat a glue pot, which investigation developed contained upwards of one gallon of water and glue, and the stove was one made for dentist's use to keep a glass of water warm.

Stoves or disc heaters should always be supplied with utensils made for them of suitable proportions and with perfectly flat bottoms.

The above illustrations and explanations are given to remind you of the necessity of learning about electric heaters; their limitations, as well as their good qualities, and the difference between temperature and heat. The difference between the application of electric heat and other sources of heat is not difficult for anyone to understand, and that quickly, but there is a difference, and for best results must be understood.

Imagine how complicated the operation of the various gas appliances would be to one who had never seen them. If they will blow it out, how would a gas range appeal to them?

The importance of thoroughly acquainting yourself with each different item by carefully reading the manufacturer's instructions and explanations, then having them put in operation under the working conditions they are designed for, is essential to those of you who propose to place them with your customers, and cannot be too much emphasized.

Take all of the articles into your own homes and give your solicitors some similar opportunity, and you will get results.

The popular articles I have referred to are what you should concentrate your efforts on until material results are accomplished, but during such period you will have demands for cooking outfits, kitchenettes, or ranges for all the kitchen requirements, as well as water boilers for the kitchen, heaters for bath water, and radiators, all of which you will occasionally find opportunity to place to advantage.

For general cooking, there are available individual cooking devices in all sizes required for the largest household; also ovens, plate warmers, broilers, griddles, waffle-irons, frying kettles. etc.

Demands for general cooking will be to fill the place now occupied by gas stoves, which, except in apartment houses are largely summer workers.

Considering for the present those cases where the principal use is in summer, it is customary when using gas stoves to operate the coal range one or two days each week for supplying hot water for washing and the bath, and of course cooking at the same time, and this reduces in many cases the demand for service to perhaps six days each week, and in considering the subject the probable practice should be an element.

Experience has shown from a great variety of sources that the number of watts per meal per person may safely be taken at 300, or 900 watts per day per person. If, however, we allow one K. W. H. per person, we have thirty K. W. for a month, which, at a five-cent rate is $1.50, or for a family of four $6.00 per month; or at a three-cent rate for the same family, $3.60 per month. While these rates are absurdly low to-day for lighting rates in residences, there are many cases where the service may be given from separate service wires at a satisfactory profit.

By careful comparison it has been determined that in cooking, an equivalent cost for $1.00 gas is 2½ cents per K. W. H., and while electric cooking is widely practical at a higher rate, it will demand from five to three-cent rates to make it an important competitor to gas. Gas, however, occupied a broad field at a much higher price than coal, due to its advantages, and electric methods make it possible for you to secure equal results because of the many advantages possessed by the newer method over the old.

For heating the general water supply, a kitchen boiler of the usual type is used varying in capacity from ten to thirty gallons, and supplied preferably with a heater contained in the boiler of a maximum of 2,000 watts, that may be reduced to 1,000 or 500 watts by a controlling switch. Such a boiler should be jacketed with ordinary pipe covering and with care is not necessarily an excessively expensive luxury. A ten-gallon boiler can be heated to 150° F. with approximately 2½ K. W., which will answer a very considerable demand throughout the day from a jacketed boiler of that capacity.

For bath water, heaters are supplied to place in the tub and those with 2,000 watt capacity are frequently satisfactory to those who understand in advance that it requires 2,000 watts for an hour to raise 20 gallons of water through 40° F.

Radiators for occasional use in bedrooms for short periods are practical and useful, but should have a capacity of not less than 1,000 or 1,200 watts to be at all effective, and except in the case of small rooms, they should be larger.

Initial temperature of water, 60° F. Efficiency of apparatus, 85%.

ONE PINT.

Total	Watts used for				Cost in cents with current at			
Temperature	5m.	10m.	20m.	1 hour	3c.	5c.	10c.	20c.
100° F.	164	82	41.04	13-68	.041	.068	.136	.272
150°	372	186	93	31	.093	.155	.31	.62
175°	468	234	117	39	.117	.195	.39	.78
200°	576	288	144	48	.144	.24	.48	.96
212°	624	312	156	52	.156	.26	.52	1.04

ONE QUART.

Total	Watts used for				Cost in cents with current at			
Temperature	5m.	10m.	20m.	1 hour	3c.	5c.	10c.	20c.
100°	324	162	81	27	.08	.136	.272	.544
150°	744	372	186	62	.186	.31	.62	1.24
175°	936	468	234	78	.234	.39	.78	1.56
200°	1152	576	288	96	.288	.48	.96	1.92
212°	1248	624	312	104	.312	.52	1.04	2.08

ONE GALLON.

Total	Watts used for				Cost in cents with current at			
Temperature	5m.	10m.	20m.	1 hour	3c.	5c.	10c.	20c.
100°	1296	648	324	108	.32	.544	1.088	2.17
150°	2976	1488	744	248	.74	1.24	2.48	4.96
175°	3744	1872	936	312	.94	1.56	3.12	6.24
200°	4608	2304	1152	384	1.15	1.92	3.84	7.68
212°	4992	2496	1248	416	1.25	2.08	4.16	8.23

For heating the bath room, many radiators are sold which to be effective quickly, should have 2,000 watts capacity. Of this size, if turned on for fifteen or twenty minutes they fully accomplish their purpose, and are not expensive to the owner.

The instantaneous hot water heater to be practical, requires that current supply of 3,000 watts and more is available. While for small quantities the cost of operation is not excessive, the service demand is undesirable and it is expensive to install, and as small water heaters are so much more simple and easy to supply, they meet the demand for small requirements.

In referring to water heating and radiators, I appreciate that the field in any community with rare exceptions is very limited, yet the sale of these devices reaches a very considerable sum annually, and is daily increasing.

The service for a family kitchen for the average family for cooking should have a capacity of about 3,000 watts, and if a kitchen boiler, bath water heater, or bath room radiator is to be included, a double throw switch can be installed in the kitchen or other convenient place so connected as to throw off the boiler, radiator, or bath circuit when the cooking circuit is required, and to avoid the necessity of extra large service capacity which would otherwise be necessary.

This also suggests a method of limiting the hours for cooking service to a period when lights are not required, but it has objections, although it is practical.

The cost for heating water to different temperatures at different rates is here given, which best tells what is required in current supply for a given result in quantity, temperature, and time as well:

My judgment is that the policy to pursue is to personally press the sale of small household devices constantly, without complicating the situation by trying to interest your customers with the larger problems, until from experience with the smaller, they have become prepared for further ventures.

During such a period you should gain practical experience in the larger problems in your own home, and you will find customers who will insist on complete equipments at such rates as you can make, and from these sources you can gain the additional knowledge to govern your future policy. The small devices will earn from $1.00 to $2.00 per month, which will cover present transformer losses and leave a profit, and the satisfaction of your customers with their use, coupled with the advantages gained by your personal interest in them as shown by such efforts to extend the service, will more than justify all your efforts.

When business depression comes, one may cut off his electric signs but not likely a house service, which provides many conveniences besides his light. Those of you who have followed the policy outlined can endorse I am sure my suggestions. That there is a large army of managers who have only begun to seriously consider this subject is my excuse for going over much the same ground as I did two years ago in a paper on this subject at the Boston Convention.

I have confined my remarks to the development of electric heating with residence customers, not with the thought that you should neglect the fertile field among manufacturers and merchants, but to impress on you the importance of the small consumer, believing it to be the most direct way of creating a widespread interest in a branch of electrical development which has a possible application with practically every customer on your lines. If it is practical in his home it will suggest its use in his business, and his demands can be met.

Large Generators for the Montreal Light, Heat and Power Company's Soulanges Canal Power Station.

The Montreal Light, Heat and Power Co. have recently contracted with the Canadian Westinghouse Co., Ltd., for a large addition to their power equipment. The apparatus contracted for is for their new Soulanges Canal power station on the St. Lawrence river. The equipment consists of three Westinghouse 3,750-kw. revolving field alternating current, two-bearing generators connected to water turbines. These generators are 7,200 alternations, 4,000 volts, three-phase, operating at 225 revolutions per minute. There are also two Westinghouse 150-kw. direct-current 125-volt exciter units. Westinghouse 2,500-kw. oil-insulated, water-cooled transformers to the number of thirteen are an important part of the equipment. Seven of these transformers will be used for raising the voltage at their generating station from 4,000 to 44,000 volts, and six of them will be used at the lowering end of the transmission line, stepping down the voltage from 44,000 to 12,000.

The Central Station

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NOTICE.

Advertisements, Changes in Advertisements, and Reading Matter intended for the next month's issue should reach this office not later than the twenty-fifth of this month.

No commissions are allowed on advertising contracts or subscriptions.

Entered at the New York Post Office as Second Class Mail Matter.

The Puncturing of Insulation

When insulation is punctured by means of a direct current it takes a pressure bearing some relation to the resistance of the insulation affected to break through the medium under stress. The manufacturers of high tension apparatus are particularly interested in the conditions which make insulation give way. The two expressions, insulation and dielectric, are synonymous in so far as the weakness betrayed by the insulation and the amount of inductive action are concerned. The degree of pressure developed ordinarily in power-carrying wires will not break through its protective covering as a rule. But extraordinary conditions prevail at times, with the result that it does give way, and in a most astonishing and apparently unexplainable manner. Perhaps the most familiar case to the general reader is that of lightning bursting through various forms of insulating materials, such as poles, windows, chimneys, trees, etc. A terrific potential like this, however, is that of inductive action due to it—a potential induced in neighboring bodies which, if sufficiently high, culminates in a disruptive discharge.

The ordinary puncture of insulation, by which is meant the breaking through of the covering of the wire, is not caused by the normal pressure of the wire. It is due to conditions developing within the circuit, which give rise to very high—an abnormal potential—for a series of intervals of time. The inductive action in this case is caused by electromagnetic influences, primarily aroused by the self induction within the circuit. It is best understood as a case of where the circuit, such as a transformer, for instance, develops within itself, when the self-induction and capacity are properly related, a condition of resonance.

Under these conditions the circuit can build up a very high electromotive force, sufficiently high with only a reasonably low pressure, to break through the insulation. If the transformer takes one or two thousand volts, and the internal coil conditions permit the reactions spoken of to exist, then it is possible that a pressure of many thousands of volts will strain the insulation to its breaking point. What is meant here, is that the electrical energy, under conditions which make the electrostatic and self-induction balance, gives rise to a potential which threatens the integrity of the insulation. To present the facts even more clearly, it is as though certain influences were operating in a pipe carrying running water, which tended to fracture the walls of the pipe. While it is well known that by suddenly turning off running water an effect of shock is produced, called the water hammer, an effect which will burst weak pipes, the effect meant here is different only in so far as it is produced by an alternating flow of current. If the walls of a pipe are weak, they can evidently be broken by an hydraulic impact, and in a similar manner, if the insulation is weak, it can be punctured by an electrical impact, as it were. While the two cases are not identical, they serve to illustrate the idea that in certain circuits carrying a comparatively low

pressure alternating current, a disruptive potential may be engendered that will cause severe damage unless understood and eradicated.

Transformers represent such an instance, as shown at times by the complete breakdown of their insulation when in ordinary service. Insulation must necessarily be exceedingly good to withstand heavy inductive effects. Many of the cases of insulation, normally good breaking down, can be traced in a variety of instances to sudden and highly injurious rises in electromotive force.

Steam Boilers and Gas Producers.

Evidence accumulates regarding the advantages of the gas producer in specific cases of central station service over the steam boiler and its natural accessories. But, as is the case, in the majority of such instances, such evidence must be examined from the standpoint of economy as well as applicability. Conclusions reached at first glance are apt to be hasty, and accordingly more or less inaccurate. On the other hand, if the conclusions reached after careful investigation, are of a character which promises a radical change in any existing system, then more than ordinary care and circumspection is necessary, before a general crystalization of that conclusion is legitimately permissible. The table of the comparative operating expenses of a steam and gas producer plant, as prepared by certain of our manufacturers is subject to the criticism, that it is apt to be biased, leaning too strongly in the direction the manufacturer would have it lean. But a certain allowance can be made for such tendencies, and whatever strict scientific information can be brought to bear upon the table, would act as a check to its accuracy. A table of the class outlined, prepared by a manufacturer of gas producer plants complete, by which is meant the gas engine as well as the producers proper, shows a series of costs on an operating basis which include all the well-known sources of heat in common use. Gasoline, at twelve and one-half cents a gallon, means the consumption of one and one-quarter gallons per brake horse-power for ten hours. Illuminating gas, at the rate of one dollar per thousand cubic feet, means the consumption of one hundred and eighty cubic feet per brake horse-power for ten hours. The cost of fuel per brake horse-power for ten hours in these two cases was seventeen and eighteen cents respectively. Then, four cases with data are given of steam engines using bituminous coal in comparison with the returns obtained from a gas producer using anthracite pea coal and thus supplying a gas engine. With bituminous coal in use at four dollars a ton, with steam consumed by a throttling steam engine, the fuel consumption per brake horse-power for ten hours averaged up eighty pounds at a cost of sixteen cents. With bituminous coal producing steam for a high-speed automatic steam engine, the coal costing four dollars a ton, sixty pounds represented the fuel consumption per brake horse-power of ten hours, costing seventeen cents. Thus, so far, the table shows, with coal consumption in the cases stated, costs for the horse-power hours given, of sixteen and seventeen cents.

With bituminous coal in use, to produce steam for a simple Corliss steam engine, the coal costing four dollars a ton, thirty-five pounds were used per brake horse-power of ten hours, costing only twelve cents. With bituminous coal used to produce steam for a compound condensing Corliss engine, the coal costing as before, four dollars per ton, the consumption amounted to twenty-two and one-half pounds per brake horse-power of ten hours, at a cost of about four and one-half cents. Thus, the various fuels cost seventeen, eighteen, sixteen, seventeen, twelve and four and one-half cents for gasoline, illuminating gas, and bituminous coal, in the various steam engines indicated. Finally, in order to institute the comparison with producer gas itself, the table gives anthracite pea coal, as previously stated, used in a producer as fuel, and developing gas, at a cost of six dollars per ton. Under these conditions, it was found that ten pounds of anthracite coal were sufficient to supply gas for one brake horse-power of ten hours, at a cost not exceeding three cents. The relative costs with all the other fuels, are thus shown to be respectively seventeen for gasoline, eighteen for illuminating gas and sixteen, seventeen, twelve and four and one-half for bituminous coal as a steam producer in various styles of engines. The fact that producer gas is very cheap is, however, not the only item to consider. The wear and tear of the engine and its various parts, the particular kind of care required to keep it in good running order, the rate of depreciation and the expense of duplicating wearing parts, the initial expense—all of these are the determining factors, as well as the cheapness of the fuel per horse-power hour. It will be evident to the lay reader as well as the expert,

that the only correct way is to estimate the element of depreciation in with the fuel cost. By this means, exactitude is attained in the estimate, that would be otherwise missing were the effect of the fuel disregarded. The point to consider is the cost of the entire mechanism producing a given amount of power. This cost embraces the wear and tear for a number of years, as well as the mere cost of fuel. The efficiency of the mechanism as a whole, and the efficiency of each of its working parts must be considered to form a just idea of its significance commercially. Small and large producer plants, are given efficiencies of from eighteen to twenty per cent. The estimate shows ten per cent. lost in cooling the gas, eight per cent. lost in gasification, two per cent. lost in radiation, or a total of twenty per cent. before it is received by the engine. In the engine the water jacket loss is figured at twenty-eight per cent., the loss at exhaust twenty-two and one-half per cent., friction loss eight per cent. and engine radiation one and one-half per cent. This total of eighty per cent. loss leaves twenty per cent as the total and useful power return.

In a two hundred horse-power condensing engine the losses added together represented a total of eighty-eight and three-quarter per cent., or a net power return of eleven and one-quarter per cent. The manufacturer thus draws a contrast between the producer plant with gas engine and twenty per cent. efficiency, and a steam plant with only eleven per cent. efficiency. Central station experts must keep in touch with developments in this field. It is highly likely that a revolutionary change is imminent here—one that may not be long in coming.

CURRENT IDEAS

For Furnishing More Light, Heat and Power from Central Stations.

Organization and Conduct of a New Business Department Suitable for Central Stations in Cities of 50,000 Population and Under.

By J. M. Robb.

"Success lies in never tiring of doing, in repeating and never ceasing to repeat; in toiling, in waiting, in bearing and observing; in watching and experimenting, in falling back on oneself by reflection, turning the thought over and over, round and about the mind and vision, acting again and again upon it—this is the law of growth. The secret is to do, to do it now; not to look away at all."

Bishop Spalding's definition of success fits the organization and conduct of a new business department as though he had it especially in mind when he penned these lines. The ability to increase the sales of current must be as assiduously cultivated as you study the means of reducing costs and bettering your service, and there is no central station so small that it can afford to get along without a new business department.

There is a general tendency to believe that others accomplish their work with less effort than ourselves, and this perhaps is responsible for the lack of confidence some central station men have in their own ability to conduct a successful new business department.

The busiest manager or superintendent, if he will persistently devote a few minutes daily to increasing his sales of current, will accomplish results as amazing as they are gratifying when he reviews them. Do not let anything prevent your beginning your new business campaign at once. Start now. Don't wait for printed forms or to think out definitely how you will go about it. When you have made your beginning you will be astonished at the opportunities for new business that will develop in the most unexpected places.

Working a new business department is like popping corn. Your first efforts produce only a cracking sound, but no popped corn. If you stop now, your work is lost. But keep on; first one kernel

pops and then another and another. Encouraged by these, more and more kernels pop until your popper fills as if by magic. If, most fortunately for you, your business seems to be in the condition of the full popper, remember the unpopped kernels that are always found when the popper is emptied.

There are plenty of unpopped kernels of undeveloped electrical business in your territory which a little attention would convert into profitable income.

Naturally your first thought will be "How much money will I spend to secure more business?" As the limit, up to which money can be profitably spent for this purpose, is in all probability beyond your means, your chief concern will be to use to the best advantage the largest appropriation you can get. Go slowly at the beginning. As a general rule, any expenditure for pushing your business will be beneficial, but there are great possibilities for waste. Hence the necessity for waiting, observing, watching and experimenting.

How shall you spend your new business appropriation? For solicitors? For newspaper advertising? Or for "Direct-by-mail" advertising?

The most efficient results will be obtained by a combination of all these methods; newspaper advertising to awaken your public to the possibilities of electric service, make your customers realize your appreciation that your business is governed to the largest possible extent by the same principles applying to any retail selling business, and to prepare the way for your solicitors.

Solicitors to call upon your possible customers, answer their questions, argue away their objections and clinch their orders, as well as to investigate the troubles of your present customers; explain your methods of handling their business, and convince them that they are actually receiving full value for the money they are paying you.

And, finally, direct-by-mail advertising, to excite the interest of those possible users of your service your solicitor cannot readily reach; to back up his arguments with those he does see, and to keep alive his prospective customers' interest between his calls.

Each of the above divisions of business getting, properly handled, will produce excellent results, but the most effective work can only be done with a combination of all three.

Endeavor to handle your new business appropriation so that your efforts will be continuous. If you must choose one of the three methods above outlined, by all means employ a solicitor and make strenuous efforts to keep him permanently at the work.

In picking your solicitors, pay the most attention to their ability to handle people.

For this work you must have salesmen, and no man who cannot handle people can ever be a salesman.

The gift of gab is not an essential, but the ability to talk convincingly is. Many a loquacious salesman spoils his work by talking too much.

Beware of the brilliant, sharp man, who works by fits and starts.

Dependability is of the utmost importance. The slow plodder who never forgets a point once mastered, will soon distance the speedy man who quickly catches on, but just as quickly tires if his first efforts are not successful.

Persistency counts for more than dash. Few prospects are interested at the first call, and just as water constantly dropping wears away stones, so patient solicitors secures profitable business.

If you have, among your employees, a man who evidences selling ability, use him for a solicitor.

Your solicitor must, of course, understand your business, but this does not mean that he must start with a working knowledge. If your man is a real salesman, he may be ignorant of the electric business at the start. A few days' coaching will fit him to begin your work and every day after that will add to his knowledge. Some gas companies have made solicitors of their regular employees, in connection with their routine work, by paying them commissions on new business secured, with the understanding that the new business work would be pushed only outside of regular working hours.

Properly handled, this practice will produce results, and it possesses the additional advantage of arousing the men's interest in pushing your business.

There is always danger, however, that the prospect of a commission will lead to neglect of some regular duty, and the practice is further likely to foment jealousy among the men.

An excellent way to pick solicitors is to advertise for salesmen and carefully study the applicants. You can soon pick out the effective men. The man who can't be earnest in advancing his own interests, certainly won't make much headway in pushing yours.

In searching for soliciting material, do not

neglect to consider how a woman can push your interests, if you can find one of the right sort.

Having picked your solicitors, take time enough to thoroughly explain your business policy to them. Discuss with them your rates, your contracts, your customs, and your rules and regulations. Make clear to them the distinction between profitable and unprofitable business. Teach them to think in dollars and cents and give them enough data to enable them to estimate the cost of connecting any business they secure.

Take them over your plant and endeavor to make them appreciate the amount of work involved in rendering good service to your customers.

If possible make a few calls with each solicitor, letting him do all the talking and then coach him between calls.

If you already have one or more solicitors, they can assist you in training the new men, but it will be to your best interest to let the beginners receive their first notions of your methods of handling your customers from yourself.

Divide your territory into as many districts as you have solicitors, arranging as nearly as possible an equal division of business and residence territory in each district, so as to give each man an equal amount of possible business.

The size of your new business appropriation will determine the number of solicitors you can use. Some companies have profitably worked one solicitor to each 4,000 of population. Each central station man must determine the number of solicitors to employ from his own conditions.

Your solicitors are now ready to go after business, but your work in handling them has just begun.

It depends on you to arouse their enthusiasm to the highest pitch and keep it there.

Have the solicitors report to you each morning as early as convenient and canvass their previous day's work. Have a little booster meeting to start the day. Have each man tell of the orders he secured yesterday, the prospects he developed, and anything which helped him secure an order.

Encourage the men to discuss the business freely and to advance their criticisms and suggestions.

Be liberal in your commendations of good work and sparing of criticism, but criticize sharply when circumstances require it.

As often as possible, explain the operation of some appliance you are pushing. Demonstrate its good points and teach the men the arguments to down any objection that could be advanced by a prospective customer.

Use every means at your disposal to increase the men's knowledge of your business, constantly impressing upon them that any increase in their efficiency is to your mutual advantage. Note carefully any articles in trade papers, etc., or any articles on salesmanship that will help your men and specifically call their attention to them, asking the men to read them carefully and then tell you what they think of the matters discussed.

Have your men 'phone to you at noon, both to let them know that you are following their work, and to advise them of any prospects which may have developed in their territory since morning.

Keep a blackboard record of each man's work brought up to date, to advertise to all the employees the work the solicitors are securing.

Have each solicitor turn in a daily report each morning, similar to Form 1, given herewith.

SOLICITOR'S DAILY REPORT.

Name .... For Date ....

Customer's Name and Address.	Contract No.	Lighting. No. 16's.	No. Arcs.	Power H.P.	Signs 16's.	Appliances.	Total Load.	Cost to Connect.	Est. Yearly Revenue.	Cash Paid.

Total for this day.
Total, week up to this day.
Total, month to 1st day of week.
Total, year to 1st day of month.
Total, year to date inc.
Electric Company.

Total Cash received by

Possible Business Index.

No Meter Set.
Service In?

Name No. St.
Owner No. Floors No. Rooms Used for
How Lighted Is Building Wired Fixtures Hung
Has Current Been Used Why Cut Off
How Heated Apparatus in Laundry
Kitchen Fuel
'Phone No. Data File No.
Mail Advtg.
Solicitor Date Remarks No. Date

Electric Company.

Possible Business Index Meter Set.

Name No. St.
Owner No. Floors Rooms Used for
How Lighted Is Building Wired Fixtures Hung
Size Meter Current Apparatus
How Heated Kitchen Fuel Laundry App.
'Phone No. Data File No.
Solicitor Date Remarks Mail Advtg.
No. Date

Electric Company.

Report of Secured Business.

No. St. Name Solicitor
Date Order Secured for
Est. Cost to Connect Est. Yearly Revenue
Revenue for Year Previous to Order Kw. Hrs. Amt.
Revenue Since Order Remarks
Kw. Hrs. Amount
January
February
March
April
May
June
July
August
September
October
November
December
Total Year
Previous Year
Increase
Meter Removed Cause

Electric Company

If any payments are collected, the amounts must be properly entered, footed and receipted by your cashier, or whoever is authorized to receive the cash.

The daily, weekly, monthly and yearly totals make possible an immediate comparison of each man's work, both with reference to current results and to results obtained in any previous period.

This form should be printed on sheets in letter head size and put up in pads. The completed sheets should then be filed in a vertical file, where they give a complete record of each man's work.

You must train your solicitors to be old business retainers as well as new business getters.

They must realize that their own, the customer's and the company's interests are all bound together.

Turn over to them for investigation the complaints of customers in their territory.

Have them look up the customer's apparatus, re-read his meter, explain to him the methods used in handling his business and make a vigorous effort to convince the customer that he has the same check on his purchases of current that he has on his purchases of any other commodity.

Energy expended to convince customers that they are receiving full value for the money they pay you, is one of the most profitable means of securing more business. If your customers are made to realize that they are receiving their money's worth in service rendered, they will use your service much more liberally and be much more open to your suggestions for their use of more conveniences requiring additional current.

It is a mistake to pay solicitors solely commissions on the sales of appliances. This practice will surely result in sales of appliances to customers who cannot advantageously use them and will certainly cause much dissatisfaction and loss to you.

A flat salary is preferable and some managers adopt the flat salary method because of the labor required to record the results of each solicitor's work.

The ideal method is a combination of a flat salary and a commission based upon the volume and value to the company of the sales of current effected by the solicitor, with a fine for business lost in the territory allotted to him.

One prominent gas company pays its solicitors a salary of $50.00 per month and a commission based on results secured, which is determined as follows:

A pool is made each month, representing a certain sum for each solicitor employed.

The various kinds of business to be secured are classified and given an arbitrary value of a certain number of points. The greatest number of points is assigned to business requiring no additional investment to serve and to business corresponding to sign and power business.

From this the business is graded down to the lowest number of points for business, which is simply renewal business, due to consumers removing from one location to another, and business requiring a heavy investment for a relatively small income.

To assist in the classification, the solicitor must report on a card the estimated cost of connecting the customer, as determined from a schedule furnished him in which are given the costs, as determined by the previous year's averages, of the various items entering into the total investment necessary to serve the new business.

He must also report an estimate of the first year's revenue from the new customer.

The ratio between cost of connecting and volume of sales is considered by the new business department manager in assigning the number of points to the business secured.

At regular intervals the solicitor's records are checked from the customers' ledgers, so that the tendency to overestimate the value of secured business may be offset.

A deduction of an arbitrary number of points is made for business lost in each solicitor's territory.

At the end of each month, each solicitor's points are totaled and the percentage his total bears to the total of all the solicitors' points determines his share of the pool.

In this particular case the sum pooled for each solicitor is $25.00, making the average salary $75.00 per month per man. Some of the solicitors on this basis earn as much as $125.00 per month.

A better way is to determine what price you can pay for each kilowatt of new business secured, grading this price from a high rate for profitable business to a very low rate for business requiring a heavy investment, and no rate for unprofitable business.

Then agree to pay the solicitors a commission at these rates for a year for all business secured, having it understood that any business lost in their territory shall be deducted from the commission at the same rates.

Such an arrangement is mutually profitable for both solicitor and company.

The business secured can be readily determined if the backs of the Possible Business Index sheets be printed as shown on sheet "A."

The solicitor should be required to turn in with cash order the corresponding P. B. I. sheet on which he has noted what his order covers.

If the order represents a customer already connected, the amount of the customer's business for the year previous to securing the order should be entered on the P. B. I. sheet and also the monthly average for the year.

The sheet should then be filed in a secured business binder under the name of the solicitor securing the business.

Each month for the year following the date of the order, the amount of the customer's business should be posted to the sheets and the increased business credited to the solicitor at the agreed rate. Such an arrangement may be kept up with a minimum of work and may be modified to suit any set of conditions.

It would induce the solicitors to devote their efforts along channels most profitable to the company, and the deduction for business lost would insure their being old business retainers as well as new business getters.

Under such an arrangement the solicitor would have every inducement to make every effort to remedy complaints and he would find it very unprofitable to waste his time selling appliances to customers who would not use them to their best advantage.

If the foregoing seems too complicated a method of handling solicitors, you would do well to reflect that the success of your new business department demands good men to carry on the work. You can secure the best work from good men only when you pay them in proportion to the results they secure for you.

Any plan which will increase the efficiency of your men in securing more business for you, is mutually profitable to every one concerned.

One of the most necessary essentials of a systematic campaign for new business is a Possible Business Index.

POSSIBLE BUSINESS INDEX.

Pope says:

"Index learning turns no student pale,
But it grasps the eel of science by the tail."

That expresses the aim of a Possible Business Index. It is to the conduct of a new business department what plans and specifications are to a piece of construction work. No two men will work up their new business data precisely alike. Where one will want a complete plan, setting forth every detail, another will be content with a free-hand pencil sketch with a very few notes.

It is well to bear in mind that when a man goes hunting he must have a pretty definite idea of what he seeks. If you have in your new business campaign a complete index of the possibilities in your territory, you will waste less of your own business appropriation.

While cards are generally used for such an index, loose sheets 5" x 8" in size and bound in binders, will be found to be far more useful, and, in addition, will give all of the advantages of a card index.

Some of the advantages over cards are as follows:

The sheets are larger, giving more space for useful data.

The sheets bound in the binders will always be found in their proper sequence, and, if necessary, can be removed from the binder as easily as a card from a file.

By using thin paper much more information can be filed in a given space.

By using a thin binder, it may be carried in the pocket and in this manner the sheets are much easier to handle in the field than cards.

Forms 2 and 3 and "A" give a set of forms for a Possible Business Index. Form "A" is to be printed on the reverse sides of forms 2 and 3. These forms are self-explanatory. The 'phone number is put in because often very effective soliciting can be done by 'phone. The data file number is to be used when correspondence or estimates, etc., accumulate in soliciting a prospect.

An envelope, large enough to contain all of the letters, estimates, etc., in flat sheets, is used, given a number and filed in your data files. The envelope number pasted to the index sheet gives quick reference to all of the data on file for the prospect.

Your Possible Business Index should contain a sheet for each house or prospect in your territory.

As your territory is extended put in a sheet for each house or prospect in the new territory.

Arrange your orders so that every meter set, remove or transfer order and every appliance order,

will go to the person in charge of the Possible Business Index, so that it will be always up to date, and show a complete list of all electrical appliances you are supplying with current.

Remember that your Index is your guide for directing your fight for more business, and the more careful attention it receives the less effort you will waste.

Use different colors of paper to indicate the different classes of new business.

For instance, white paper to indicate a building where no current has ever been used.

Yellow paper to indicate a building now being supplied with current. Make the sheet for this class of business show an itemized statement of the connected load.

Red paper for a building where current has been supplied, but, for some reason, has been disconnected.

Brown paper to indicate power prospects.

Green paper to indicate sign prospects.

Properly laid out and handled, the Possible Business Index will not only show the possibilities for business, but it will also show the amount of work done on each prospect, and when the business is finally secured, the index sheets can be used to keep a record of the business obtained by each solicitor. This is easily accomplished by noting on the sheets the orders to be credited to the solicitors and then filing them in a separate binder behind the name of the solicitor who is entitled to credit.

Then, periodically, the revenue from such business can be posted to the sheets credited to each solicitor and his income earning value is thus readily determined.

One of the best methods of starting your solicitors is to have them first go over their territory to make up reports for the Possible Business Index. In this manner the ice is more easily broken for a new man and he quickly becomes familiar with his territory.

Periodically, at regular intervals, depending upon your local conditions, have your man check up the New Business Index and carefully make the necessary corrections.

If you are mailing matter to your prospects, this practice will not only save money in postage, but the moral effect upon your prospects will increase the efficiency of your new business department many per cent.

To assist in keeping your Possible Business Index up to date, give your solicitor credit for any business closed in your office, where the index shows the solicitor has called on the customer within thirty days of the date of the order.

NEWSPAPER ADVERTISING.

Your new business department can be made to prosper without the aid of your newspapers, but, if you are wise and your appropriation permits, you will use them liberally and continuously.

Properly used, the newspaper will aid you in molding a favorable public opinion and it will also secure new business for you. If it does nothing else, it will pay its cost in the increased efficiency it will produce in your solicitor's work. The newspaper adds a dignity to the house to house work, of your men, which it would otherwise lack.

Use as much space as your appropriation will buy, but use it continuously. Don't splurge, unless your appropriation will stand it. Consider, also, how the average person scans his newspaper and you will realize that if you would have your advertisements noticed, they must be arranged so that "he who runs may read."

This means that your newspaper talks must be very, very short, sharp, pithy, incisive. They must stand out so that upon the paper being opened the advertisement at once catches the eye. Plenty of white space must be used to accomplish this.

The following excellent suggestion is taken from the *Electrical World and Engineer*, of March 25, 1905:

"In preparing copy for newspaper advertisements the central station man must bear in mind that his efforts will not be searched for, except by himself. Neither can he, as a rule, use sufficient space so that his ads. will demand attention merely on account of their size. His problem, therefore, is to devise a means of insuring that his announcements will be read without resorting to anything bizarre or in bad taste.

"The plan here suggested has proved very successful, and anyone who adopts it will find that his advertisements will be the most prominent things on the pages which they adorn.

"It consists essentially of the purchase of a few fonts of a large, legible type to be used for your own announcements, exclusively, and differing from anything in regular use by the paper in which they appear. The type in which the advertisement here

reproduced (but reduced to about 16 points), is set, is known as 28-point Caslon Old Style and has the reputation of being the most legible face ever cut. It can be used to advantage in two ways—first, as in the example given, in a few lines well spaced and surrounded by plenty of white space, and second, in two or three lines well spaced, as before, and followed by matter in small type. While Caslon Old Style is probably the best type for this purpose, there are other plain, bold and legible faces which can be used if the Caslon is pre-empted, though, as a matter of course, the results will not be so good if others are already using the same idea. When there is no competition in the lighting business, it is just as well in this style of announcement to omit all reference to name and addresses. It is 'different' and that in itself is good advertising. The following are offered as suggestions for 'copy.' Some of them are original, others have been culled from various sources.

"In papers of ordinary get-up as to their advertisements it is surprising how impossible it is to look at a page containing one such as I have described without seeing it first, almost to the exclusion of everything else. Two fonts of type, costing about $8.00, will set up any of the advertisements which can be set in the space commonly used."

In connection with the above, note the Macbeth lamp chimney ads. running in the magazines.

Give your newspaper talks direction. Select some person or prospect in your city, as nearly typical as possible, of the prevailing type of people whose business you are going to get and address all your talks to him. It has been demonstrated in training street car conductors to call streets and stopping places, that announcements are much more easily understood if the conductor will direct his talk to some individual in the car, instead of just talking into space.

The same thing holds good in advertising.

You are going to persuade people to buy your service.

Very well. Point your arguments for some particular individual. Be direct, come to the point at once.

Use old-fashioned plain English, the kind that says "Keep Out" instead of "No Admittance," or "Come In" instead of "Visitors are Welcome."

Use common sense. "The man who has the truth in his heart need never fear the lack of persuasion on his lips."

It isn't necessary that you be able to write flowing sentences.

You have a story to tell. Imagine that you have your prospect up in a corner where he can't get away. Talk to him, but be brief.

Select some phrase to correspond with "Cook with Gas." Use it to head every advertisement and follow it up with a reason why.

Here are some suggestions:

LET ELECTRICITY DO YOUR WORK.

Get an electric iron. Then your ironing will be done with half the time and work. One will be sent to you on thirty days' trial if you 'phone to No. ——.

Get an electric warmer for baby's food. Then you won't have to chase down stairs nights to the gas stove.

Put up a porch light, with the street number on the globe. Keep it lighted evenings. Let your friends know where you live, when they call.

How about the wear and tear that clothes wringer takes out of your clothes? An electric centrifugal clothes wringer will save it.

Ever hunt for things in your closets with matches? Electric closet lights are cheap fire insurance. Put them in now.

Do you use a chafing dish? See the electrical chafing dishes at (your address).

Does your wife sew?

She certainly will appreciate an electric motor to drive her machine. Order one on trial.

Do you use power?

An electric motor will furnish it at less expense than anything else you can get. Telephone No. —— for particulars.

An electric fan will chase the flies out for you. Send in your order now.

Change your copy every day. This is important and it will lead many people to look up your ads. to see what you will say next.

The more people whom you can get to think about your business, the faster will it increase.

Keep a scrap book file containing copies of every advertisement you run. If you will arrange your scrap book in the order in which your ads. appear, it will form an excellent means of checking your monthly newspaper bills.

Study every ad. that comes to your notice, in your endeavor to make your own ads. different from

the others with which it is printed. The effort will pay big returns.

DIRECT-BY-MAIL ADVERTISING.

A campaign of direct advertising by mail will still further increase your solicitors' efficiency. Mail will easily reach customers, who will never see a solicitor, or get to them at times when a solicitor's call would be considered an intrusion and resented.

Be chary, however, of your use of circular letters, and do not place too much faith in the selling power of multi-colored direct-by-mail stuff, artistically folded like a table cloth or bed sheet.

Business men to-day are busy. A sentence in black type on a plain postal will make an indelible unconscious impression, where a choice collection of pictures on a square yard of wrapping paper will only produce an emphatic cuss word and a vigorous shove toward the waste basket.

The chief value of a circular letter is the personal appeal. Therefore, is the necessity for its preparation with consumate care, to give it all the effect of a personal appeal to the reader.

Most circular letters are an abomination and unless you are sure of your ability to convince your man that it is his interest and business, not yours, that you are pushing, you would better stick to your postals.

If you do send out circular letters, enclose with each one an addressed postal (not a mailing card without a stamp), so that when your letter makes the desired impression, the postal will be mailed before your prospect changes his mind in hunting for a one cent stamp.

Be sure, too, that the postals are numbered for identification, for sometimes prospects mail cards, forgetting to sign them.

If you have an addressing machine, have the addresses of your prospective customers set up for it and arrange to keep it up to date. This will put you in position to effectively and quickly reach your prospects with any proposition you want to push.

Number consecutively the printed matter, mailing cards, circular letters, etc., that you send out: keep a scrap book with copies of all such matter and have the date and number stamped upon your Possible Business Index sheets. By tabulating the orders secured from each lot of matter mailed out, as shown by the entries on the Possible Business Index, you are in position to judge the effectiveness of what you are distributing.

COÖPERATION WITH EMPLOYEES.

Do not end your work among your own men with training your solicitors. Work up the interest of every man connected with the company. Make them all see the possibilities that can be obtained if every man makes use of the opportunities for boosting the company's business that come to him every day.

Organize a progress club among the men, with meetings to be held monthly, or oftener, at which matters relating to the service, the sales of appliances, their use, the betterment of the service, etc., can be discussed. Invite their criticism and study their suggestions. This work will cost much in time and energy, but better results will be secured than can be obtained in any other manner.

SALESROOM.

Your salesroom is a most important adjunct of your new business department.

First impressions count for everything with some people, and for something with everybody. Your conditions will govern the quantity of apparatus you can display, but even if you show only a flat iron, you can show it, if you will, so that it will attract interested attention.

Don't neglect to have a glass case wattmeter connected up, so that you can demonstrate its operation any time.

Make use of the pamphlets, etc., that manufacturers of electrical apparatus will supply you for the asking. Everything helps.

CATALOGS.

Keep carefully filed, for reference, every catalog of current-using apparatus you can obtain. Study your catalogs and have your solicitor study them. They will suggest endless applications demanding the use of current, many of which can be profitably used by your consumers.

APPLIANCE POLICY.

Make your selling prices for appliances bring you the same rate of profit a dealer would expect, but scrupulously put into advertising or soliciting every cent of such profit. This practice will encourage dealers to handle electrical appliances. Coöperation is what you need and the more people in your territory who can be induced to push electrical appliances, the better will it be for you. The practice of

selling appliances at cost or less than cost, further has the tendency to confirm the popular opinion of the profits from the sale of the current. Then too, many people measure the value of an article by its price and emphasizing the low price of what you are selling depreciates it to them.

Selling electrical appliances is more a matter of salesmanship than price.

Convince your customers of the value of your service. Create in them the desire to use it. It can be done by persistent work. Make your terms easy; small payments on long time and they will buy.

Offer every appliance you handle on trial long enough to thoroughly demonstrate its convenience and utility.

Follow up every appliance sold, with a careful inspection, to ascertain that it has been properly set and that its operation is thoroughly understood.

Push forward the merits of your service and leave price the last thing to discuss when you have shown how desirable and useful a thing your service is.

In exceptional cases, your margin of profit will permit you to arrange exchanges to secure profitable business you could not otherwise get, because of the customer's investment in concurrent consuming apparatus.

COÖPERATION WITH CONTRACTORS.

Display in a prominent place in your office a wall directory of all the electric contractors in your territory.

Arrange to send them immediately any tips coming to your notice concerning wiring work.

Keep in touch with your contractors, establish friendly relations with them and consider their criticisms and suggestions.

Their coöperation is a valuable means of extending your business and is well worth your strenuous efforts to secure and hold.

Keep informed of the local work your architects have in hand and arrange for regular reports from the building inspector's office.

Knowing in advance of projected new buildings or remodeling work, you can furnish advance information to your friends, the contractors, and their self-interest in securing the work will make them effective solicitors for you.

PUBLICITY.

Make use of every legitimate means of securing desirable publicity for your company.

Establish friendly relations with the editors and reporters of your newspapers.

In most small towns, news items are not plentiful and much profitable publicity can be secured through tactfully acquainting your newspaper men of current happenings, such as contracts closed, contemplated improvements, etc., or handing them an occasional clipping describing some electrical appliance or some new application of electricity.

Should you, unfortunately, have an accident, prepare your own version for your papers. It will save them the trouble of writing it up and insure your public having the story as you want it told.

Remember your business is bound to receive a certain amount of attention from the press. If you will make the effort, you can direct it to your advantage.

Make every piece of company property carry its advertising message. If there is no ordinance prohibiting it, put a permanent enameled sign on every one of your poles. You need not incur the expense of equipping all the poles at one time, but by buying permanent signs you can put them up on the instalment plan, without finding the expense too heavy a burden.

The benefit to be obtained by circulating a monthly bulletin among their customers and prospective customers is not properly appreciated by central station men.

Most electric men fully realize the benefits their companies bring to the community they serve, but too many forget that there is no one except themselves to exploit these benefits to obtain the public appreciation they merit. Electric men, and gas men, too, for that matter, have too long been guilty of "hiding their light under a bushel."

Energetically pushing forward the many advantages of electric service, both to the customers and to the community as a whole, will do more than anything else to disarm the hostile spirit too often manifested against central stations.

There is no one to do this save the central station men themselves, and no better way to accomplish it than the monthly bulletin.

The practice of advertising appliances on or with monthly bills for service is of doubtful value. The recipient of the bill is then in the least receptive mood for suggestions to increase his use of current.

The bulletin method is more costly to be sure, but it deserves careful consideration among your other plans for extending your business.

Give your wagons, tool carts, etc., especial attention. Paint them often and keep them clean.

Make your entire equipment carry its message of wide-awakeness and progressiveness to your community.

CULTIVATING POPULARITY.

Aim to be considered in your community as a public benefactor.

Use a portion of your new business appropriation for purchasing advertising space in programs for church entertainments, etc.

The space so purchased has little advertising value, but when the character and energy of the people behind church and charitable organizations is considered, the importance of securing their good will is apparent.

The amount paid in each case need only be a small one, but it is important that this matter be so handled as to build up a coöperative spirit and that your customers appreciate that you are anxious to lend your assistance to anything promoting the public welfare.

In this line of work, beware of the professional advertising scheme promoters.

If possible, arrange to loan cooking and other apparatus to church and charitable organizations free of charge, including current used. Stipulate, however, that a representative of your company shall superintend its operation to demonstrate the apparatus and to make use of any opportunity to promote your interests that may occur.

Your efforts along this line of work will certainly go far towards establishing your company solidly in the good graces of your customers and possible customers.

Never let any adverse criticism of your company, by any individual in your community, go unanswered.

Public service companies have so generally neglected to answer hostile criticisms that the public generally has come to consider that they have no answer.

Whenever you hear of a disgruntled individual, ascertain as quickly as possible what his grievance is, and either show him where he is wrong or right his trouble. A few people you will find whom you cannot convince, but your efforts in this direction, persistently followed up, will bear rich fruit.

CONCLUSION.

You have doubtless noted that there is nothing new or radical in what has been advanced in this paper for the organization and conduct of a new business department.

These things have all occurred to every man who has given persistent thought to the work and will occur anew to the men who will engage in it later.

It would perhaps be difficult for any one man to follow all of the lines suggested, but every man doing central station work can, if he will, start with some one line of effort in this direction.

The start is the all important thing, for if the work be followed up, new ways and methods will be constantly suggested to the persistent worker.

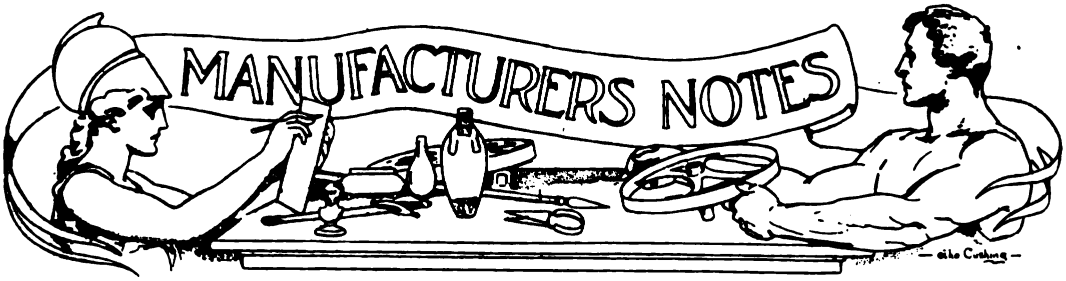
Thoreau says: "I learned this that, if one advances confidently in the direction of his dreams he will meet with a success unexpected in common. If you have built castles in the air, your work need not be lost; that is where they should be—now put the foundations under them."

This also applies to the new business work.

Dream your dreams of satisfied customers lighting their homes, their factories and their stores with your current, driving their machines with your power; cooking their meals with your appliances; advertising their business with your signs. Then work, work day and night to make your dreams come true.

Work; everlasting; never tiring; patient; persistent work, that is the secret of a successful new business department.

Among recent orders for electrical machinery, the National Brake and Electric Co., of Milwaukee, reports the following: George W. Pitkin & Co., Chicago, Ill., 1-100 K. W. engine type alt.; Clinton Sugar Refining Co., Clinton, Ia., 1-400 K. W. and 1-75 K. W. engine type alt.; Alliance Electric Light and Power Co., Alliance, Neb., 1-100 K. W. belted type alt.; Fort Morgan Electric Light and Power Co., Ft. Morgan, Colo., 1-75 K. W. engine type alt.; Stillwater Gas and Electric Co., Stillwater, Minn., 1-250 K. W. engine type alt.; Clymer Power Co., Riegelsville, Pa., 1-500 K. W. water wheel alt.; Hendrie & Bolthoff Mfg. and Supply Co., Denver, Colo., 2-150 K. W. water wheel alt.; Rockford Malleable Iron Works, Rockford Ill., 1-200 K. W. engine type D. C. gen.; Romadka Bros., Milwaukee, Wis., 1-150 K. W. engine type D. C. gen.



The Stanley-G. I. Electric Mfg. Co. have recently placed on the market a flame arc lamp known as the Stanley-G. I. "Brilliant." These lamps are made for either A. C. or D. C. circuits, both type being of the converging carbon construction, *i. e.,* both carbons feed downward toward each other so as to focus the arc at the same point; thereby eliminating

shadows and preventing the formation of non-conducting slag at the carbon tips.

The mechanism of the D. C. lamp is of the differential magnet type, while that of the A. C. lamp is of the differential disc motor type; the carbons in both cases being regulated by chain feed. Both types are designed, adjusted and carried in stock to burn two in series on 110-volt circuits—standard resistance being furnished with the D. C. and a reactance coil with the A. C. lamps. All lamps are adjusted for 12 amperes, and an arc voltage of 45. Both golden yelow and white light carbons can be used on the D. C. lamps, but golden yellow *only* will be furnished for the A. C. lamps.

The weatherproof steel casings, finished in bright japan, are the same for either lamp and are interchangeable. The feeding mechanism is contained in a separate compartment of the case, so carefully partitioned off from the arc that it is unaffected by the heat or loose slag.

The Murray Iron Works, of Burlington, Iowa, are just now building two 22" x 36" Murray Rolling Mill Type" Corliss engines for direct connection to generators. Both of these are for the United States Light and Traction Co.—one is to go to Hobart, Oklahoma, and the other to Sheridan, Wyo. They are also building an 18" x 36" "Rolling Mill Type" for direct connection to a generator that is going into the power plant of the Iowa State College at Ames. This is an engineering school of large size, which stands very high here in the West. They are also building an 18" x 36" engine for direct connection to generator for the Shenandoah (Iowa) Electric Light Plant and also have an order for a complete power plant for a new electric lighting company in Basin, Wyo.

The Buckeye Electric Co., of Cleveland, Ohio, manufacturers of the well-known incandescent lamp of that name, has recently opened an office in Dallas, Tex., located at 216 Commerce street, in charge of Mr. H. E. Wells.

The Trumbull Electric Mfg. Co., of Plainville, Conn., has just issued a very attractive little circular entitled "How Shall We Know Good Switches?" It illustrates and describes their standard product in this line, and explains and illustrates, by diagrams, the detail of their switches which have made them famous.

Minneapolis Steel and Machinery Co., of Minneapolis, Minn., have just issued two very handsome illustrated catalogs concerning their suction producer gas power systems, and their Twin City Corliss steam engines. The former illustrates and describes the Munzel gas engine and gas producer, which is now creating so much interest in the central station field, and is a most comprehensive treatise on this new prime mover. Their Corliss engine catalog consists of 69 pages, and illustrates and describes in every detail their Twin City Corliss engines and their factory and facilities for the manufacture of this type of engine, which is now to be found in many of the most representative power houses in this country. Both of these catalogs will be sent to the reader of THE CENTRAL STATION upon request.

The Atlas Engine Works, of Indianapolis, whose Chicago sales offices have for several years past been in suites 900-902 Fisher Building, will, upon completion of the new Fisher Building in November, increase their present rather cramped quarters by the addition of several larger offices. Mr. Frank H. Baker, connected with the Atlas for over twenty years, will continue at the head of its Chicago organization.

J. F. Davis, formerly connected with the Pittsburg organization of the Atlas Engine Works, Indianapolis, has been transferred to the Company's offices at Chicago.

If you are interested in advertising in the form of verses, you will no doubt be pleased with the booklet entitled "Sunbeams," recently published by the Sunbeam Incandescent Lamp Co., of Chicago and New York. The cover is of gray stock, printed in blue and yellow; and the typography is neat and effective. A copy will be mailed to any one upon request.

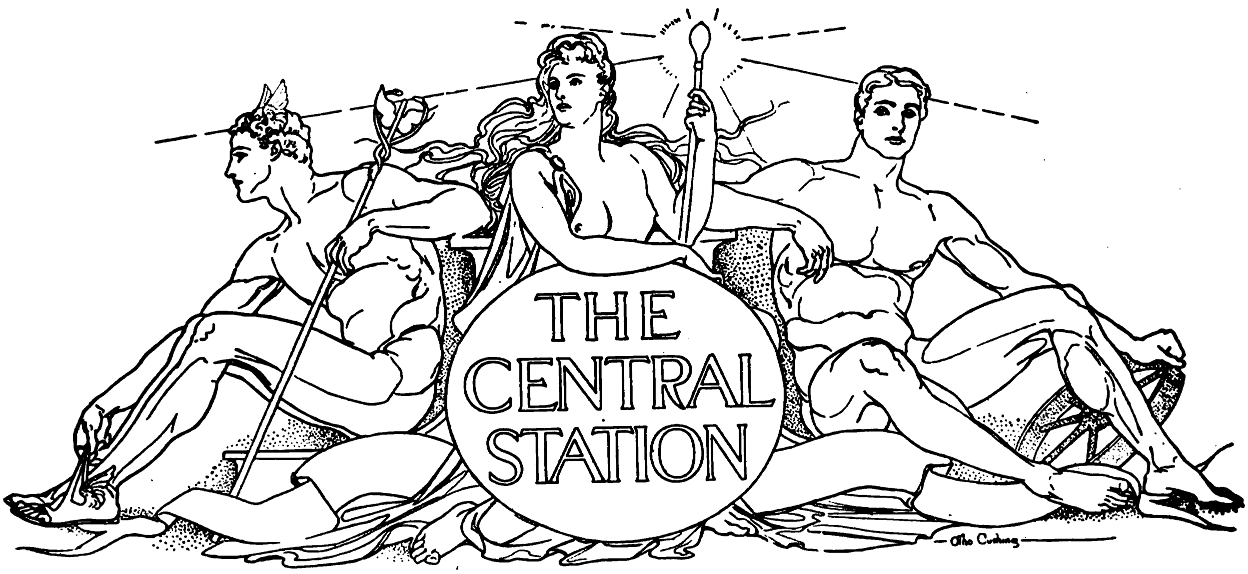
The De La Vergne Machine Co., Foot E. 138th street, New York, reports the following among other recent orders received for "Hornsby-Akroyd" oil engines: Central New England Ry. Co., Hartford, Conn., 7 h.p. geared to pump; F. J. Stokes Machine Co., Philadelphia, Pa., 25 h.p.; The Hastings Pavement Co., N. Y. City, 16 h.p.; The W. F. Norman Sheet Metal Mfg. Co., Nevada, Mo., 50 h.p.; Union Ballast Co., New York City, one 20-h.p. and one 32-h.p.; D. P. Forst & Co., Trenton, N. J., 13 h.p.; Webb Wire Works, New Brunswick, N. J., 32 h.p.; Messrs. J. W. Lippincott, S. P. Scott and Max Meyer, Little Rock, Ark., 50 h.p. engine to drive a De La Vergne ice machine.

The Trump Manufacturing Co., of Springfield, O., manufacturers of the celebrated Trump "Model" turbines for low, medium and high heads, have just issued a most attractive and interesting 80-page catalog illustrating and describing their turbines, as well as many of their recent installations. This catalog contains, also, a large quantity of most useful data for determining and utilizing various water powers, and it will be sent to the readers of THE CENTRAL STATION upon request.

Burlington Municipal Lighting Plant, Burlington, Vt., has recently contracted with the Westinghouse Machine Company for a Westinghouse-Parsons turbo-generator unit. The turbine will be direct connected to a 3-phase, 2,300-volt, 60-cycle turbo-alternator, running at 3,600 revolutions per minute, and will operate on 150 pounds of steam with 28" vacuum.

This plant adds one more to the list of successful American municipal lighting plants that have adopted steam turbines; notably the Public Light Commission of Detroit, and the city of Columbus. In the Detroit plant a 2,000 k.w. Westinghouse-Parsons unit is in operation, and another is on order; in Columbus the entire plant is equipped with Westinghouse-Parsons turbines aggregating 1,200 k.w. capacity.

Power and Mining Machinery Co., of Cudahy, Wis., has just issued its publication No. 102, illustrating and describing its Loomis-Pettibone gas generating plants, which are now meeting with such success in the large electric lighting and power stations in which they have been installed.



DEVOTED EXCLUSIVELY TO THE INTERESTS OF ELECTRIC LIGHTING AND POWER STATIONS.

VOL. 6, No. 5. NEW YORK, NOVEMBER, 1906 ISSUED MONTHLY.

Central Station Light, Heat and Power Principles.

By NEWTON HARRISON.

Switchboards for Polyphase Circuits. — The control of power circuits is best obtained by the use of special switchboards so designed that the apparatus necessary to exercise their control is conveniently situated for use. In order to simplify the arrangement of these various devices, the switchboard is considered in an analytical manner, and the apparatus attached to it classified with respect to their individual functions. It is to be noted, however, that the switchboards themselves and the apparatus they contain may be divided up into low potential switchboards and high potential switchboards.

Low Potential Switchboards. — The elements of a switchboard of this character may be regarded as consisting of the following:

Panels of a Low Potential Switchboard:

1. Generator panels.
2. Feeder panels.
3. Rotary converter panels.
4. Polyphase motor panels.

The construction or manufacturing department of large concerns make panels of this character (Fig. 1) their standards. A switchboard is therefore built up of a series of parts, as enumerated. They are called panels, and as such are held together by means of a frame consisting of a rectangular iron support resting on ornamental legs. Clearance between the floor and the lower part of the frame of about two feet completes the design. The iron legs are broad and removable. In case extra panels are required, these legs may be removed and marble panels inserted with whatever apparatus is necessary. Some of the panels below, in this case will be set in blank. The general list of apparatus employed on the switchboard is comprised in the following schedule:

1. Indicating voltmeters.
2. Field ammeters.
3. Swinging voltmeters.
4. Switches.
5. Rheostats.
6. Synchronizer.
7. Ground detector.
8. Fuse blocks.
9. Transformers.
10. Compensators.
11. Wattmeters.

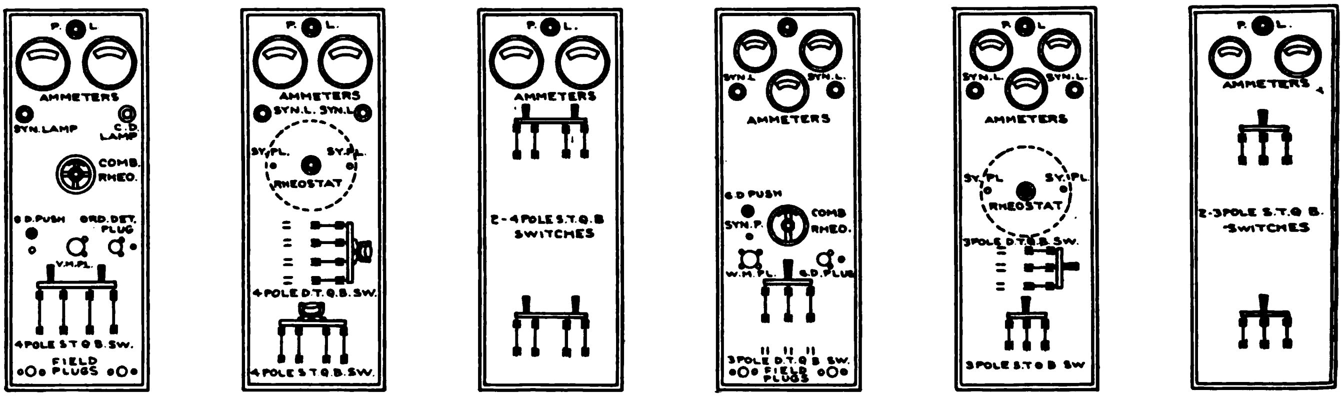
Indicating Wattmeters. — Instruments of this description are employed for the purpose of enabling the switchboard attendant to obtain the voltage of any phase of the system or of any generator by the use of a plug switch inserted into a voltmeter receptacle.

Field Ammeters. — The field of the generator carries current, the amperes of which it is desirable to know. Means are therefore employed to connect one or more ammeters into the field circuit for the purpose of determining this current when desired. The name field ammeter is sometimes given to this instrument when so utilized.

show, to the phases they make or break. What are called "spade handles" are provided with four-pole switches, and a handle of special construction, called by the manufacturers reinforced, for the three-pole switches.

Rheostats. — The back of the generator panel holds the rheostat. Before entering further into a brief description, it is well to state that the rheostats are of two types—one for the exciter and the other for the generator. Hand wheels are employed to turn the contacts which do not appear on the face of the panel. Only a dial is seen with a movable index. This gives a relative idea of the operation of

FIG. I.



NO. 1. TWO-PHASE GENERATOR PANEL.

NO. 2. TWO-PHASE ROTARY CONVERTER PANEL.

NO. 3. TWO-PHASE FEEDER PANEL.

NO. 4. THREE-PHASE GENERATOR PANEL.

NO. 5. THREE-PHASE ROTARY CONVERTER PANEL.

NO. 6. THREE-PHASE FEEDER PANEL.

Swinging Voltmeters. — Voltmeters of this description simply swing from the side of a panel by means of an arm or bracket. When a second generator panel is installed for the purpose of operating more machines in multiple, the use of another voltmeter is therefore installed to occupy a place beside the first in the bracket, or swinging arm. A means of ready comparison is thus instituted between the two voltmeters and the pressures of each generator examined for differences. It also possesses the advantage of giving a good view of these two instruments from any point of the switchboard.

Switches. — These devices are naturally required to make and break quickly. The time in making contact and the abruptness in breaking it are matters of the greatest importance in this class of equipment. The switches are made with three and four pole contacts, suitable, as a little reflection will

the rheostat when varied by means of the wheel handle. In some instances the rheostat is employed at a distant point from the switchboard, and only the face plate with its various connections led to the panel. The generator referred to is the alternating current machine into whose field circuit the exciter feeds. Both the exciter and the alternator fields are therefore controlled by individual rheostats as described.

Synchronizer.—When two or more alternates are to be thrown into multiple it is necessary to use a device which will show when the current waves are in unison. Unless this is attended to, interference will result and the lamps flicker constantly. A synchronizer is therefore employed by means of which the machines can be thrown together without risk in this respect. When the generators are run in multiple, the generator panel receives the indi-

vidual currents from each machine and it is delivered through a switch to the bus-bars. Every separate circuit possesses an ammeter. If there are

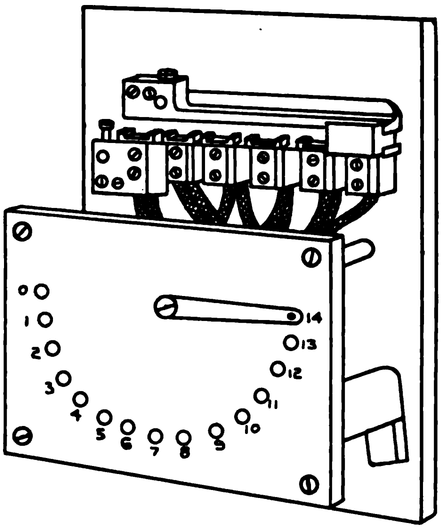


FIG. 2.—COMPENSATOR WITH ADJUSTING ARM AND CONTACTS.

different phases, an instrument for measuring current is also employed. If the generators are run in multiple, from each generator panel connections are made to provide them with a synchronizing lamp.

Ground Detectors and Fuse Blocks.—A ground detector is a device by means of which any leg of the circuit may be tested for grounds. The use of two lamps in series, connected to the ground at the point of connection between the two lamps, and so arranged by means of a switch, that a test may be made as desired, constitutes the general character of the apparatus. Whichever lamp burns brightest indicates the position of the ground. If the lamp connected to the right hand leg burns brightest the left leg is grounded and vice versa.

Fuses for alternating current service are generally mounted on porcelain backings, which in turn are contained in an iron box. They are specially protected with regard to the lineman. When blowing, the operator is protected from injury by the position they occupy in the porcelain foundation. Transformer fuses are made single or double pole. Lead wire is dispensed with for all currents over 10 amperes. Beyond this point copper is frequently employed, although aluminum is also desirable. A type of porcelain tube is employed which forms part of the porcelain foundation and which occupies a front position in the forward part of the fuse block; this contains the fuse and, as previously stated, protects the lineman whether the box is near his hands or not, or whether it is opened or closed. In some designs of fuse blocks the porcelain tubes are readily removable. As they contain the fuse itself, it is readily evident that the removal of this tube and the insertion of another involves no risk of dangerous contact. The fuse when blowing, expels the volatilized metal through the porcelain ends and thus protects the device from injury. It is to be understood that a fuse box must be waterproof. The presence of moisture would rapidly invite electrolytic and other actions. Heavy grounds ultimately resulting in short-circuits, would be incurred if it were otherwise. Special means in the shape of bushings are used to exclude all moisture from metal parts which might be injuriously affected.

FUSE BOX DATA.

Voltage.	Maximum Current.	Information.
1,000	10	Double pole in cast-iron box.
2,000	2	
1,000	10	Double pole without box.
2,000	2	
3,000	30	Double pole in cast-iron box.
3,000	30	Double pole without box.

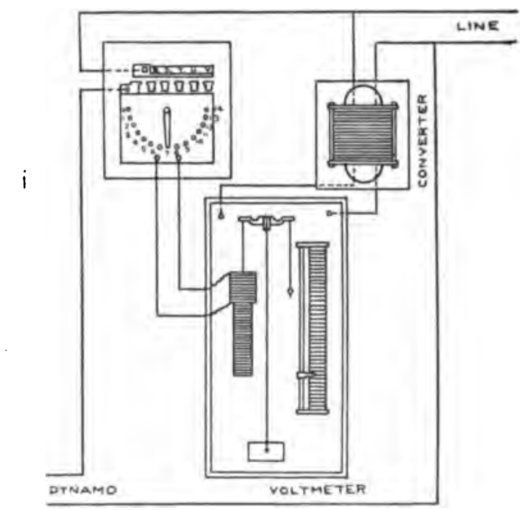


FIG. 3.—CONNECTIONS OF THE COMPENSATOR, CONVERTER AND VOLTMETER.

The Compensator.—The description of the purpose and function of the compensator (Fig. 2), is comprehensively stated in the pamphlets of manu-

facturers of this class of apparatus. It is inherently useful in indicating the pressure at the point at which the current is consumed. In this respect the power plant pressure is greater, as can be readily understood, but the compensator fulfils the peculiar purpose of connecting the voltmeter indication of this drop between the two points. The transmission of power problems involves the sustaining of the correct pressure at the points, not only of distribution, but of consumption as well. The termini of the feeding system must, therefore, be watched carefully to remedy any great difference in pressure between them and the station proper. The ohmic drop is readily understood as being depended upon the resistance and current. These, in their place, are necessarily dependent upon the dimensions of the feeders and the load they carry. With but one circuit, the problem is simple in its nature. With many, however, it represents complexities that invite the use of the device to be described. The complexities are those due to the same station or generator particularly supplying current to circuits in which conditions exist which call for independent regulation in each. One manufacturing concern argues as follows: "In some cases where the load varies over a wide range, it may be advantageous to permit a considerable drop during the limited time that full load is supplied in order that the first cost of the line may be reduced. This necessitates supplying at the power station a voltage considerably higher than that required at the load. In other circuits carrying a full load most of the time, it will be more economical to install a conductor of large current-carrying capacity, at a corresponding increase in the cost, so that the percentage of drop may be kept within reasonable commercial limits. In these cases the voltage supplied at the power station will be but a few per cent. higher than that required at the load. It is evident, therefore, that in many cases the cost of transmission circuits can be considerably reduced providing suitable regulating devices are installed at the station. It is also important that means be provided at the power station to indicate the E. M. F. at the load, otherwise it is impossible for the attendant to regulate the voltage properly. The old method of accomplishing this was to run small wires, from the end of the circuit back to the station, these wires being large enough to carry a sufficient current for the voltmeter without an appreciable loss. This method was very expensive and if carried out with any degree of completeness, resulted in a great deal of complication. It is evident that the cost of installing pressure wires is prohibitive when the feeders cover the great distances which are now common in lighting and transmission plants. A simple, inexpensive and thoroughly effective method of accomplishing the same result is afforded by the compensator."

Compensators are made of two types, one to serve in compensating for ohmic drop only and the other to compensate for both ohmic and inductive drop. The attendant in charge of the ohmic drop compensator, can readily adjust the pressure until the candle-power of distant lamps is normal, irrespective of the intervening drop.

Wattmeters and transformers have received attention in the preliminary treatment of this subject. The compensator is a transformer, according to the description given by one manufacturer, the primary of which is connected in series with the supply circuit. The number of turns in the primary coil of this device is capable of variation. They may be adjusted, and the same is true of the secondary; but the secondary is connected to a voltmeter; the result of this system is as follows: "As the load on the circuit increases, current through the primary increases, and the action of the secondary current on the voltmeter increases. In some types of compensators the secondary is connected in series with the voltmeter circuit. The secondary of certain standard types is connected to an auxiliary coil wound around the voltmeter solenoid. The action is similar to that of a series coil on a compound wound generator. The current from the compensator is opposed to the current in the solenoid, and as the action of the auxiliary coil increases, the current through the main solenoid must be increased in order to give the same resultant pull on the core. This requires a higher pressure on the voltmeter itself, and consequently an increased pressure on the circuit. The amount of compensation depends upon the number of turns in the auxiliary coil."

In the illustration (Fig. 3), the connections are shown including the R. S. T. U. V. plug contacts and the auxiliary coil around the voltmeter solenoid. The adjustment of the secondary is also shown where the numbers 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, are visible. This last governs the current in the auxiliary coil around the voltmeter solenoid. Compensators are made for an amperage of

160 or less and a frequency of from 16,000 to 7,20c alternations.

In more highly developed types, irrespective of the nature of the load, the current, power factor, reactance and resistance are all taken into account. Special adjustment is made in allowing for ohmic and inductive resistance when compensators are installed.

Prepared for THE CENTRAL STATION by Colin P. Campbell, Attorney.

Liability for Death by Shock From Telephone.

This case if directly involving a telephone is yet of interest to Central Station managers, because of the language used and because of the rule laid down in regard to the duty of a telephone company. The facts appear to be that the father of the appellees was a patron of the appellant. During the month of February, 1902, there was a severe storm, and the connection of his telephone with the exchange was broken. This disconnection continued for some weeks, and, according to the theory of the appellant, which seems to be accepted as correct, the telephone was not connected with the exchange at the time the decedent was shocked to death in taking hold of the transmitter. The allegations of the appellees, as set forth in their statement, is that the appellant, "by its careless and negligent management of its wire system, permitted one of its wires, which was not properly insulated, to come in contact with the wires of another company, heavily charged with electricity, whereby the said electric current was conveyed to the said telephone of said Thomas F. Delahunt, when he was making proper and lawful use thereof, whereby by reason of the premises and the negligence of the said defendant company he received a heavy stock of electricity and was thereby then and there killed." During this disconnection of the decedent's telephone with the exchange he received a letter from the manager of the company, which was properly admitted in evidence by the court, and of which the following is a copy: "United Telephone & Telegraph Company, March 18, 1902.—Mr. Thomas F. Delahunt, 21st and Edgmont Avenue, Chester, Pa.: Dear Sir: I regret to hear that you have been among the unfortunate subscribers living along Edgmont avenue, and assure you that we are making every possible effort to get you back into service, and hope to do so by the last of this week, or the first of next. I will gladly make your 'phone one of the special importance and get you connected at the earliest possible moment. We are going to renew your service up Walnut street, thus explaining the seeming neglect of that part of the city. Yours very truly, W. P. Hall, Manager." On the evening of April 9, 1902, a sound resembling the noise made by a cricket came from the direction of the telephone, and the deceased said: "I believe that is the 'phone. I wonder if it is in use." He then got up, walked over to it, and took hold of the transmitter with both hands, drawing it down. As he did so there was a flash of flame all around the telephone, and he was almost instantly killed by an electric shock. After the appellees had shown this they were about to prove the specific negligence charged against the appellant, when the learned trial judge, evidently of the opinion that the case came within the rule res

ipsa loquitur, told them that it was not necessary to do so, and that the testimony which they proposed to offer might be admissible in rebuttal, if the defendant should show it had exercised proper care. It offered no testimony, and on this appeal from the judgment on the verdict against it the important and main question is the correctness of the ruling of the trial judge that the plaintiffs were not required, in the first instance, to prove more than that their father was killed by an electric shock in using the instrument, which with its connections, the appellant had furnished to him as one of its subscribers.

This ruling was made on the authority of Alexander v. Nanticoke Light Co., 209 Pa. 571, 58 Atl. 1068, 67 L. R. A. 475. Electricity is the agent by which telephones become the means of communication from one point to another, and it may be conceded, as the appellant contends, that the current needed for their use is not a dangerous one. In this case it may be still further conceded that the current with which the deceased came in contact did not come from the exchange of the appellant; but at the same time it cannot be questioned that it came over one of its wires leading to the telephone of one of its patrons. Though this wire was only intended to conduct a harmless current the appellant was bound to know that it could become the conductor of a deadly one, and that such a current would pass over it, if it was not properly insulated, and should come in contact with a wire heavily and dangerously charged. It was, therefore, as much the duty of the company to see that no such current should thus pass over its wires, as it was to send only a harmless one from its own exchange. Its duty to its patrons was to exercise at all times the highest degree of care and vigilance to protect them from a dangerous electric current over its wires from any source. This is the implied undertaking of every telephone company, and in towns and cities threaded with dangerous electric wires the duty of the company is, by constant supervision of its wires, to prevent them becoming conductors of a dangerous current from others. When they do become conductor of it, there is reasonable evidence that there has been a neglect of duty, and the burden is cast upon the telephone company of showing that it had not been negligent. As it is not an insurer of its patrons against the danger of electric currents on its wires, the law will not hold it responsible for what it cannot help and for what may happen in spite of its exercise of the care and vigilance required of it; but when, as here, there is an accident, which in itself affords reasonable evidence of negligence, it must show why it should be relieved from liability.

By a number of assignments of errors we are asked to say that the court erred in not directing a verdict for the defendant on the ground of contributory negligence of the deceased. Counsel for appellant very properly states that the current of electricity necessary to operate a telephone will injure no one. The deceased knew this, and, of course felt that his telephone was as harmless as it was useful, and there was no reason why he should have hesitated to take hold of the transmitter. He had been notified by the manager of the company that the connection of his telephone with the exchange would be established "at the earliest possible moment," and when he heard the noise coming from it, he evidently thought it had been connected, for he said: "I believe that is the 'phone." In then getting up, walking over to it and taking hold of the transmitter, he did just about what anybody else would have done under the circumstances; but because he happened to stand on a wet carpet and the transmitter was made of metal, it seems to be seriously contended that he was guilty of negligence, and that the court ought to have so instructed the jury. If the current of electricity needed for telephones were dangerous, a consideration might possibly be given to this proposition, but it cannot be so dignified under the facts in the present case. In submitting the question of the contributory negligence of the deceased to the jury, the appellant was given a chance to escape, of which the appellees might fairly have complained, if the finding had been against them. The assignments of the appellant relating to this feature of the case are all overruled.

Delahunt v. United Telephone & Telegraph Co., 64 Atl. Rep., 515.

Conflicting Rights: Induction Currents: Leakage.

One of the most important principles in electrical science is that of induction. Probably it may be said in safety that there could not have been tangible progress in the application of electricity to light and power purposes were it not for the fact that the proximity of a conductor surrounded by a current of electricity induced in another nearby conductor

another current of electricity. This great fact, however, while it has meant so much to electrical science and progress, has been attended by serious difficulties. One of these has been the fact that parallel conductors have had their respective currents disturbed by their proximity. Because of the importance of this subject and the fact that but few cases in which questions of this sort have been discussed are in existence, we shall occupy more time in the dicussion of individual cases in this branch of our subject than has hitherto been done.

At the outset it must be borne in mind as the general rule that the company first on the ground is prior in right. In this field, however, in which we are now entering, one of the great exceptions to this rule is made manifest. Perhaps it is not permissible to call it an exception, but rather a modification. Among the earlier cases was the case of the City & Suburban Telephone Co. v. The Cincinnati Incline Plane Railway Co., 11 Ohio Discussions 106, in which it was held that the telephone company that had first occupied the street was entitled to an injunction against a street railway company using the single trolley system, to prevent its operation until it should install a double trolley system, when the return or ground current of the street railway company, which used the street for the return circuit, interfered with the telephone system, which also used a ground line. This case, however, was overruled by the Supreme Court of Ohio in the case of the Cincinnati Inclined Plane Railway Co. v. The City Suburban Telephone Co., 48 O., St. 390; 27 N. E. Rep., 890; 29 Am. S. Rep., 559; 12 L. R. A., 524, holding that the difficulties arose partly from conduction and also, in addition to this, from induction or leakage. It was also declared in this case that these interferences with the telephone service could be obviated by the railway company giving up the single trolley system with the ground circuit and putting in a double trolley system with the metallic circuit. That the telephone company might obviate the injury by constructing a complete metallic circuit for each line, or by using the McClure device, being a metallic circuit consisting of a single return wire for a large number of outgoing wires. In addition to this it was shown that the railroad company was operating under a franchise which was previous to that under which the telephone company was operating. That is to say, that when the telephone company began business it found the street railway company in operation, using, however, horses as motive power. This, however, was not taken as the controlling feature of the case, in spite of the holding that the street railway company was entitled to substitute electricity for animals as a motive power. The court finally holding that, notwithstanding the fact that the telephone company was entitled to the use of the street for its lines, that nevertheless, the street was for purposes of public travel; that its use by the trolley line was in harmony with this primary purpose, and that the use by the telephone company being subservient to the legitimate use of the street for public travel was also subservient to such use of the street by the railroad company, and, therefore, the telephone company was not entitled to an injunction restraining the use by the railroad company. That the casement of the street railway company was paramount and took universal precedence.

Another case was decided in the Federal Courts the same year by reason of an injunction of the same sort as that complained of in the Ohio case. In this case the court pointed out that the double trolley system might be used to obviate the difficulty, but did not consider this was practicable. The court also pointed out that a complete metallic circuit for each line in the telephone system would obviate the difficulty, but declared this impracticable, because the expenses of installation and maintenance for the telephone company would be doubled. The McClure device was pointed out and the Court said that it considered this practicable.

The injunction was finally denied, the Court declaring that it did not consider that the use of the single trolley system by the street railway company was such an unreasonable use of the street in the exercise of its franchise as would enable the maintenance of a bill or even the recovery of damages. In passing, however, the Court said, if in the case under consideration it were shown that the double trolley system would obviate the injury to complainant without exposing defendants to a great inconvenience or large expense, we think it would be their duty to make use of it and it would not have been out of our power to aid the complainant by an injunction; but, as the proof shows that a more effective and good device is open to the complainant telephone company, we think the obligation is upon it to adopt it and that defendants are not bound to indemnify it, and the damage done to the complainant is not such as is justly chargeable to the

defendants. Unless we are to hold that the telephone company has a monopoly of the use of the earth and of all the earth within the city of Nashville for its feeble current, not only as against the defendants but as against all forms of electric energy, which in the progress of science and invention, may hereafter require its use, we do not see how this bill may be maintained. Cumberland, etc., Telephone Co. v. Universal Electric R. Co., 42 Fed. Rep., 273.

Another case which will be very briefly noticed is that of the Hudson River Telephone Co. v. Watervliet Turnpike Railroad Co., 135 N. Y., 393, in which a difficulty was experienced similar to that in the other cases which we have mentioned, but in which it appeared that the telephone franchise was granted on the express condition that the maintenance of its lines should not interfere with the enjoyment of the street railway franchise; and it was accordingly held in that case that the railway company's use of the earth for a return circuit would not be enjoined.

How to Make a Small Electric Plant Pay.

By D. F. McGee.

How to make our electrical properties earn a dividend for their stockholders is a subject that is engaging the attention of the brightest minds of the country. The author of this sketch undertakes the task with fear and trembling, but, believing it to be the duty of every central-station manager to contribute his mite toward hastening the solution of this very important problem, he has responded to the request of our president to furnish to this association a paper describing the methods which we adopted to transform into a dividend-earner an electrical property, operating in a town of five thousand population, that had previously been a losing investment. Neither time nor space will permit an elaborate article on this subject, on which volumes are written weekly for our trade papers.

It has been proven that an entirely modern equipment is not essential for the financial success of an electric plant, and a wise manager of a small plant will hesitate before he consigns to the scrap heap equipment that he might, by overhauling and judicious arrangement of same, be able to operate at a net efficiency equal to the most modern equipment, besides saving for his company the amount required for new equipment and increased fixed charges that must necessarily follow such an expenditure. On the other hand, if he finds that his requirements and conditions call for an entirely new installation, he should not hesitate to make it, provided he can get the funds to do so—which is often difficult in a small plant.

The boiler room is usually the most neglected part of a small plant equipment. Uncovered pipes, leaky valves and joints, improper boiler setting, careless firing and injudicious selection of fuel, are a few of the dividend-consuming devices common to small plants. It is well to have as few different sizes of valves, fittings, etc., as possible in the piping equipments. By making the nipples and short pieces of pipe of some uniform length, repairs will be simplified and many a shut-down be prevented, and a much smaller stock of fittings will provide for emergencies.

Boilers should be inspected at regular intervals and kept free from scale. Scale in boilers is often the cause of enormous waste of fuel. Every steam plant should have recording thermometers installed in the feed-water lines to boilers. The average engineer in the small plant does not realize the necessity of heating boiler feed water to, at least, 200 degrees.

Many central-station managers would have a rude awakening if they would take the trouble to install recording instruments. Recording voltmeters, as well as thermometers, will provide a healthy incentive for your men to attend to their duties, and will also provide a means by which that mystery of voltage variation, which has given us all so much trouble at various times, may be solved. It is well known that one of the chief difficulties in small plants is to have competent help available when accidents or other trouble occurs, which is

generally during the time of the heaviest loads. We have provided for this by dividing the power-house force into three watches, with the understanding that they are to work ten hours per day. This provides double force on duty two hours each day to make all repairs and tide over the peak-load period.

Engines should be indicated regularly, and valves adjusted for the most economical steam consumption. Tests of water and fuel consumption should be made at stated periods. A log book should be kept, showing records of the hourly readings of the various instruments. Daily readings should be made of the switchboard wattmeters. No plant is too small for those instruments. If a plant cannot afford load-curve drawing instruments, the engineer or switchboard attendant should plot the daily load from the ammeter readings on sheets similar to chart No. 1. The curve thus drawn will bring before you plainly that hollow place in your load line that must be filled before you can corral that dividend-earning germ which we are all striving to cultivate with more or less success.

The distributing system of a small plant is very often the source of considerable waste. The annual losses from poor line contruction, inefficient transformers and badly-designed feeder systems, would go a long way toward paying dividends. The line and transformer losses on above-mentioned plant at present are only 60 per cent. of what they were five years ago, when the income was only 25 per cent. of the present earnings. We scrapped thirty transformers and replaced the entire lot with four large ones, using three-wire secondary network with banked transformers to take care of this large increase in business.

The first duty of every manager is to provide for reliable and continuous service. He must furnish "the goods." Excuses won't go with the up-to-date American citizen.

His next duty is to his company. He must see that it receives an equitable return for money invested by it to provide the equipment to supply this service. Before he can do this, he must first know, beyond question, what constitutes the various costs that go to make up the entire operating expenses of the plant. He must be able to make a monthly comparison of his various costs, for it is only by this means that he will be able to keep a check on his operating expenses. By studying carefully all the facts and factors that constitute his costs, the manager will be able to steer clear of the folly of taking on improfitable business.

In plants located in cities with populations of ten thousand and less, the manager must be familiar with every detail of his business. He must be his own solicitor. It has been said that an outside man can interest and get customers that the local manager cannot reach. If he can, it is because he is a man better fitted for the business. The manager of a small plant should know ways and means of approaching a prospective customer that a stranger cannot know. He should study the ambitions and weaknesses of every prospective customer. Often it is the wife and mother that should be approached, perhaps in an indirect manner. Very often it is the

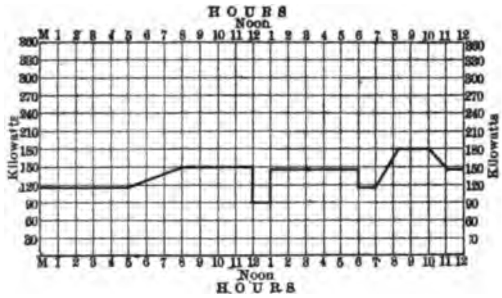


CHART No. 1—LOAD DIAGRAM JUNE 22, 1905

Horizontal lines show kilowatt-hours Vertical lines represent hours of day, beginning at midnight.

daughters of the house, who aspire to have as many conveniences as their neighbors. A hint from any source should not be neglected. There is always some way to land an interested party. A manager is not worthy of the name if he cannot find a way to do this.

Above all, a solicitor must be specific, and must be thoroughly posted regarding cost of installation and cost of operating the article sold; also regarding maintenance of same. He must be able to say: "Buy this; it will cost you so much to install and run, and will give you so much profit." He must be able to meet any argument that may be advanced by his competitors. Above all, he must be truthful. He must not make rash promises. It is well always to allow a factor of safety in this respect. How gratifying it is to hear from a customer that he is getting better results than you promised him. I can recall one incident that has afforded me considerable pleasure, as well as profit. A German owned a blacksmith shop in our little city. After a lot of hard talking, I got him to install a small motor to operate his tools. Some time after, I called at

his shop and enquired how he liked his power. He replied, "One boy put that thing in here, but it would take several good men to get it out again." As he is a very profane man, he used much more

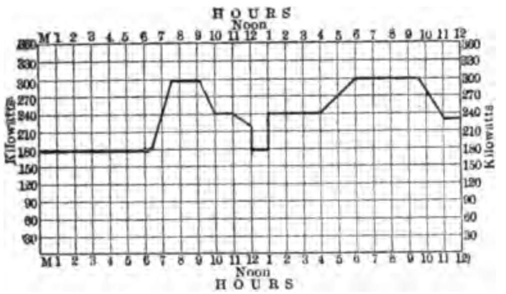


CHART No. 2—LOAD DIAGRAM JUNE 13, 1906

Horizontal lines show kilowatt output. Vertical lines show hours of day, beginning at midnight.

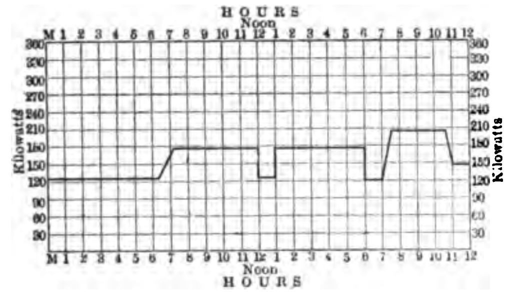


CHART No. 3—LOAD DIAGRAM MARCH 24, 1906

Horizontal lines show kilowatt output. Vertical lines show hours of day, beginning at midnight.

forcible language to express himself on this subject. I have used this story many times since, and must say that it has helped to close up the sale of a good many motors.

It is not necessary to be a "hail, fellow, well met." A man does not have to be a "mixer" in the accepted sense to get business. That fallacy has been exploded long ago. A pleasant, cheerful manner, and character to back up his arguments, is his best stock-in-trade.

The manager of a small plant must keep posted regarding the latest and most efficient types of different apparatus, lamps, reflectors, and so forth. He should read all the trade publications; not only the reading matter, but should study the advertisements as well. He will miss a great deal of valuable information if he does not. He will often find the solution in those pages of some difficult problem that has bothered him for months. Many manufacturing concerns gladly furnish binders for their literature. This matter, when properly assorted, represents a mass of valuable information that can be acquired in no other manner, so there is no excuse, save "that tired feeling," for a central-station manager not being up-to-date.

It is somewhat difficult to convince a customer that if his requirements call for a 25-hp. motor, he would only have to pay for five to ten horse-power. A very large proportion of the load that can be secured by a small plant is intermittent. The customer averages a payment for only about 25 per cent. of his actual installation. By carefully studying the requirements of all prospective customers and familiarizing yourself with their actual costs, you are then in a position to go to any one of those customers with a proposition that will save them money. If you can show the average man that you

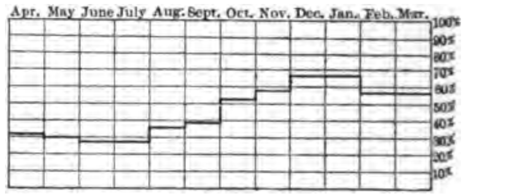


CHART No. 4—LOAD FACTOR FOR ONE YEAR

In Chart No. 4, 100 per cent represents the total capacity of plant in kilowatt output for year of 365 days, operating 24 hours per day.

The plotted curve represents kilowatt output as registered by switchboard meters during each month of past year. There was no current generated during daylight hours, on Sundays or legal holidays, making a total of 560 hours that plant was shut down during the year, or over six per cent of the entire time.

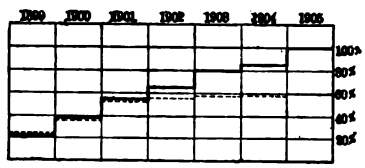


CHART No. 5—RATIO OF OPERATING EXPENSES TO GROSS EARNINGS

In Chart No. 5, 100 per cent represents gross earnings for six years, beginning 1899. Dotted line represents cost of operating expenses, insurance and taxes for same years.

This plant had been in operation for about ten years previous to 1899. Twenty-four-hour service was started in that year. The writer took charge of the plant in April, 1900.

The above chart shows that it is absolutely necessary to put the plant equipment in the best possible condition before you can hope to keep the operating cost as low as consistent with first-class service.

can cut down his expenses or decrease his manufacturing costs, you will have no difficulty in getting his business.

One of the most desirable classes of customers

is the small refrigerating plant; especially when they install brine cold-storage tanks. Arrangements can be made with this class of customers to shut down their motor during peak loads. The cost of this class of power would be only the net additional cost of fuel and proportion of your general expense, as it does not increase the peak load on the station. A careful analysis of costs will work wonders toward helping the manager of our small plants in building up that hollow of low business in daytime.

The manager must be able to plan the most efficient arrangements of machines. In very many cases, such as machine shops, grouping the machines will permit the most efficient operation. In other cases, such as printing plants, individual motor drive is preferable.

It pays to study every installation, giving your prospective customer your very best advice, for there is no advertisement so cheap and good as a satisfied customer. Above all, create confidence, for confidence is the foundation of new business. Pay every attention to the little things. The average user of power knows nothing at all about electricity or mechanics and cares less. What he wants is to see the wheels go round. Have your trouble man call at the various installations at stated intervals, making a report to you of any abuse or misuse of the equipments. The average patron will appreciate this. He can well afford to pay a small sum for this inspection to insure him against a shutdown.

One of the best means to increase your business is to coöperate with architects and builders. The advice of a disinterested party will go a long way with the house owner.

Be prompt in looking after trouble. Let your customers know that their troubles are yours. Make yourself and your service indispensable to them; keep posted in regard to the troubles of users of other sources of power. We have often taken advantage of a breakdown in both steam and gasoline engines to install a motor to help them out of a difficulty, and we have never had occasion to take the motor out afterwards, as the engine would invariably pass to the second-hand man.

With all due respect to advertising, it must be thought, however, that the getting of new business, in a small city, is dependent on advertising alone. There must be good and reliable service as a foundation for all this. The service must be continuous and free from interruption. Voltage must be steady. With such good voltage regulators on the market, there is no excuse for poor regulation. Customers' installations must be looked after by the central-station manager to insure their being maintained in good condition. He must watch the little things, keep dim or other inefficient lamps weeded out. At an early date we adopted a liberal policy regarding free lamp renewals.

It is also essential to have a schedule of rates that will attract the long-hour or all-day customers for both light and power.

You must educate the people away from the idea that electric light is for the well-to-do only, for the difference in the yearly cost for redecorating houses where electricity, gas or kerosene is used will often more than pay the entire electric light bill for the year. Where electric light alone is used, the redecorating cost is about one-half as much as it is where the other illuminants are used.

Regarding advertising in local papers, it is very necessary to retain their good-will, and some money can be spent in this manner to advantage.

A short time ago there was an epidemic of burglaries in our city. To one paper we furnished a news item, supposed to be an interview with a reformed burglar, stating that he always gave an electrically-lighted house a wide berth while he was in the business, because he never could tell when a light would be snapped on him from an upper story.

To another paper we furnished a news item, to appear as a statement by a noted detective, advising people to have their houses wired so that the lights in the lower rooms could be switched on from an upper story. We were indebted to an electrical trade paper for this hint. We believe that we received more benefit from this one item in one issue of two newspapers than we should have received from a *bona fide* advertisement running a year in the same papers. The idea is to take advantage of the psychological moment to instil your proposition into the minds of your prospective customers.

The foregoing charts show the results we obtained by the above methods. In charts Nos. 1, 2 and 3, the curves indicate daily kilowatt output for different periods of past six years. Chart No. 4 represents load factor of plant as described. Chart No. 5 represents the ratio of operating expenses to gross earnings for the past six years.

The Central Station

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No commissions are allowed on advertising contracts or subscriptions.

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The Transformation of Central Stations.

Since the question first arose as to whether electricity would ever become a force of commercial use, tremendous strides have been made in the direction of making it an essential element of every-day life. But it is not alone this widespread application of electricity to light and power which demands attention. It is a matter of more interest perhaps, to examine into the character, and the changes in character, which has occurred in the *ensemble* of those sources of electrical energy commonly called central stations.

This change has been noted by modern-minded engineers, as a proof of the elasticity of every-day practice. It is a striking evidence of the degree to which changes are instituted on the basis of a well-founded, though partially crystallized scientific principle.

To be more explicit, it may be stated, that a rapid transformation is taking place in the design of the operating mechanism of central stations. As a central station is best designated as an institution in which electricity is generated for direct distribution and consumption, it may not be difficult to understand how changes occur in the class of machines housed under such a roof. These changes are very marked at certain intervals, indicating transformations through definite periods. Formerly the change was one indicating a strong tendency to use large multipolar units, instead of a variety of small two-pole machines. Of necessity, this expansion led to the abolition of the use of small high-speed engine units, and the heavier build of slow-moving engines of the marine type took their place. Thus, the station was gradually evolved from the first period of development, consisting of small bipolar dynamos belted to high-speed engines, into the second stage of growth, represented by a series of slow-speed multipolar generators, direct connected to correspondingly heavy engine units. What can be called the third period of development, now regarded as the most radical of its kind in the last half century? The answer to this interrogation is best found in the statement that the third stage of central station development and transformation is discovered in the introduction of the turbine.

It might be asked, how can the introduction of the turbine affect the central station so markedly? Or, in what respect are such advantages gained that in the substitution of one type of steam consuming apparatus for another is to be hailed with approbation? Only a purely commercial reply can be made to this inquiry. It is decidedly cheaper, the consulting engineer is apt to say, to install and employ turbines.

He will show that the lowering of expense is found in the more limited rate of depreciation; in the greater economy of operation, and in the reduced consumption of oil. The greater ease of coupling is not as great nor as important an item as the reduction in floor area. It is far better he will say, to produce continuous motion by steam or any other power if possible, than a series of dis-

connected and reversing impulses. The reciprocating engine is thus debarred by natural law, he will argue, from standing on the same plane of mechanical adaptability as the turbine. As there is in this, as in the generator, only rotation to consider, it is not susceptible to the same wear and tear as a mass of linked mechanism needing constant attention and careful lubrication.

This, therefore, is the point of greatest interest—the saving in labor, or money, for care and attention. The explanation of the transformation of central stations into plants of a radically different basis of internal design is thus found. Experimentation with gas engines is only another phase of the problem. The tendency at present, as far as it has developed in actual practice, is threefold: The reciprocating engine in one phase of growth, the turbine the second, and manifestation, and the gas engine and producer plant the third.

If floor space can be occupied to better advantage then more generating units can be installed. The logic of this, seems not only to be a saving in specific directions, but what is equally important, an ability to utilize the space of the central station to such advantage that a greater income can be secured from it. As the saying goes, making two blades of grass grow where one grew before, is the idea embodied here. As a consequence of this, the latest statistics show a revolutionary change impending in central station design, no less than 900,000 h.p. in turbines in use in such institutions at present, and a large number of gas plants in operation and being installed. Saving in expense of operation and less floor space per unit, have proved to be dominant influences in the reshaping of central stations within the last decade.

A Tesla Invention.

Tesla has been called the Father of Power Transmission in the United States, though this limited discrimination is hardly just, for the reason that his influence extended through Europe as well as this country. But aside from any eulogistic references to his work, which could only be intelligently appreciated by those familiar with certain details of his inventions, there occasionally crops up a sort of aftermath of his earlier efforts, in the shape of litigation directed against those whom he regards as infringers. In saying "those whom he regards as infringers" the statement might be better broadened so as to include "those who possessing his patents regard as infringers."

But the source of legal discussion which was terminated before Judge Kohlsaat in the Circuit Court of the United States, hinges upon the invention of the split-phase motor, as it is called. A little light on this subject will certainly prove interesting to those desirous of grasping more than the mere superficialities of argument generally associated with such analyses and only reaching the public ear. The body matter of the argument was, therefore, this: The complainant insisted that the first claim of a given Tesla patent broadly covered the fundamental method of operation of split-phase motors. Also that the second claim of the same patent is for the specific application of the underlying principle of operating such motors by means of divided circuits of different electrical character and certain other apparatus claims.

The defendant, however, urged that the method claim and the apparatus claims of the two patents in suit are simply different verbal expressions of exactly the same inventive thought; that a defense to one was a defense to both, and that the same inventive thought may be found in patent No. 401,520 and certain English patents against the Tesla patents numbered 511,559 and 511,560 of the complainant.

But in the opinion handed in by the judge the following statement was made: "At the date of the filing the patents before the court, Tesla had already invented the polyphase motor and system. He had solved the difficulty of utilizing the alternating current in starting and raising the speed of the motor into synchronism with the generator. This he accomplished by means of sequence of currents as they emanated from the generator. This system required special generators and the use of two or more circuits, and was cumbersome and expensive, especially when sought to be applied to systems where the units are small.

To meet these objections, Tesla evolved the method and appliances of the patents in suit. "I have," he said, "discovered another method of operating these motors, which dispenses with one of the line circuits and enables me to run the motors by means of alternating currents from a single original source. Broadly stated, this invention consists in passing alternating currents obtained from one original source through both of the energizing circuits of the motor and retarding the phases of the current

in one circuit to a greater or less extent than in the other."

The judge furthermore showed how the two independent currents were dispensed with by Tesla, and replaced by one, and the path of the circuit split and necessarily the phase, by adequate means, to retard the current in one path to a greater extent than in the other. There is, of course, more in the matter of detail than this, but the basic ideas are no different from those presented in this brief review.

The conclusion reached was for the complainant, and in so reaching it, justification was given to the rights of the inventor. Tesla has been credited with ambiguities at times, that have been the means of reacting severely and injuriously upon his title to genius; but despite this, there is in the man's work —the work of his brains—as found in the archives of the United States Patent Office, every evidence of a supreme ability that betokens the master. Crediting a man for the real work that he has done is only justice. In this respect Tesla deserves many honors, for he has risen far above the ordinary standard of electrical achievement through the advantages of a remarkably able and extremely scientific mind.

Art Fixtures in Electric Illumination.

The poetic and the prosaic are not always so closely related, as in the instance of a practical system of electric lighting upon the design of chandeliers and fixtures. In this industry the incandescent and arc lamp have been made the basis of a series of artistic inventions, upon which crystallized art principles now rest.

Large office building vestibules and halls, finished according to Greek or Pompeian styles of interior decoration, are illuminated by fixtures which betray the correct impression of lighting done in those days. In these the light itself is provided by incandescent lamps whose ready adjustment to interpreted ideas enables designers to carry out their plans in all essential details. Art fixtures thus represent to-day what they did not and could not represent twenty years ago.

The ease with which concealed wires are so situated within the foliage or figure design that the art effect is enhanced by the light seeming to emanate from the thing itself, is one of the triumphs of modern art illumination. The large manufacturers of electroliers and artistically designed wall and ceiling fixtures, have long since realized that the general use of electricity is the one and only means by which these art ideas have been applied to interior design. Magnificent results have been obtained in the fine hotels and apartment houses, as well as the office buildings thus equipped. This joining of interests has proved an effective spur to the development of lighting as well as the art ideals it now embodies.

The result of this coalition has been the establishment of new standards in lighting, in not only an artistic but a scientific sense as well. By this is meant, that lamps, whether arc, incandescent or otherwise, must be constructed with a certain guaranteed life, light and current consumption. The investment of large sums of money in art effects in the class of buildings mentioned means lighting apparatus that will not call too heavily upon the pocket or patience of the landlords. Excellent lamps have been the result, with indisturbed art fittings, with the consequence that neither the elaboration indulged in, nor the system in use for lighting, have in the majority of cases, been other than highly satisfactory.

The Series Versus the Polyphase Motor.

Details of tests of series-wound motors running with single-phase current have been placed before the public from time to time. Though in some instances the significance of these reports may have been lost to them, the general impression was conveyed that the motor referred to, namely the series wound, possessed qualities which gave it a chance to aid in simplifying the present system of alternating current generation, transmission and distribution. The impression was furthermore conveyed, that it might serve as a substitute for the present railroad motor in street railway and suburban traction. Thus, it seems the die has been cast, and in the arena of public and expert opinion, competition of a gigantic nature is about to begin to determine the relative values of the series-wound motor on single-phase and the polyphase motor on multi-phase circuits.

The simple winding of the series-wound motor, the simple form of current it can take, and the ease and efficiency with which the power it absorbs can be transformed up or down to any reasonable pressure and transmitted over two lines, are the strongest arguments in its favor.

Both types of motor are self-starting; in this respect they stand equal, but the difference appears in the greater cost of the transformers, in the greater cost of rotary converters, and in the greater difficulty in starting to two or three-phase motor from rest without a heavy rush of current. By substituting for the three-phase transformer and rotary, the single-phase transformer, sub-stations may be so reduced in first cost as to be almost negligible in comparison with those now erected. Simplicity in this respect means also greatly reduced cost; and as the extent of the investment is to the backers of large schemes the governing principle, the single-phase circuit operating a series-wound motor may win out.

The point of greatest importance, which the consideration of this problem presents, is the reduction of the system down to a simple basis from a formerly more or less complicated one. The idea which should be paramount, is not that constant additions to meet new and increasing difficulties are the thing, but the reverse. In other words, there is every reason to believe, that whatever invention develops along practical lines, is doubly welcomed, if it represents instead of more complexities, a simplification of the rendering of the idea. To pass from two and three phase back to single phase, is the sum and substance of success according to this principle, in other respects it is wisdom to wait until such success is more widely advertised.

MONTHLY REVIEW OF THE TECHNICAL PRESS

The Semenza Porcelain Insulator at the Milan Exhibition.

The advanced position now held by Italian engineers in the field of electric transmission is again shown, by the new porcelain insulator exhibited in the kiosk of Messrs. Richard-Ginori in the Milan Exhibition.

All insulators now manufactured must be made sufficiently large to stand the electrical and mechanical strain under all atmospheric conditions, and one of the worst of these conditions met with in practice is the case of severe rain storms.

To guard against this rain trouble, it has been usual up to the present time to make the upper petticoat with a very large diameter to enable it to protect the lower part of the insulator, whose surface, being thus kept dry, would offer the necessary resistence even during severe rain storms.

A sectional view of an ordinary insulator is shown in fig. 1, this being a type frequently used in Italy, in which the wire is fastened to a "head" forming one piece with the upper petticoat.

This necessitated making the whole of this petticoat of the same insulating material, which formed the chief part of the insulator, and it had to be made with just as much care as the lower petticoats.

The recent tendency to increase the working pressures, and the resulting greater distance which must be maintained through the air between the "live wire" and the grounded support, made it necessary to correspondingly increase the diameter of the upper petticoats, which resulted in a great increase in cost.

Signor Guido Semenza, the well-known Italian

consulting engineer, and Hon. Secretary of the Italian Electrotechnical Association, devised the type of insulator, of which a section is shown in fig. 2, and the final details have been perfected by the engineers of the Societa Ceramica Richard-Ginori, after a large number of experimental trials made in the electrical testing laboratory connected with the works of the company at Doccia, near Florence.

It will be seen that in the Semenza insulator the wire is fastened below the upper petticoat. It is, therefore, unnecessary for this petticoat to be strong enough to resist perforation. It need only be water-tight and sufficiently hard to resist mechanical shocks and rough usage in transportation. It is

FIG. 1.

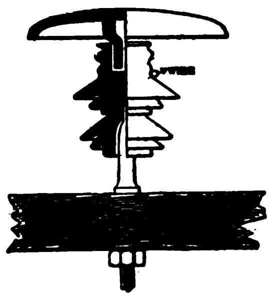


FIG. 2.

therefore, made of a form of terra cotta which is neither so costly nor so breakable as porcelain or glass.

Since the point of attachment of the wire in the Semenza type is somewhat lower than in the old type, the "strain moment" of the wire is greatly reduced, which enables a reduction to be made in the thickness of the insulator and in the diameter and cost of the iron bolt; and since this upper petticoat or umbrella is not connected in any way with the pin, complications due to increased capacity are avoided.

The great improvement and the advance of this insulator over the old types is well illustrated in fig. 3, which shows a comparative test made between the old and the new pattern. Reference to the figure will show that a common wire connects the "heads" of the two insulators; this is led to one terminal of the transformer, the other terminal being placed in the alkali bath in which the pins are supported. The breakdown under the conditions shown above, was at 76,000 volts under a rainfall of

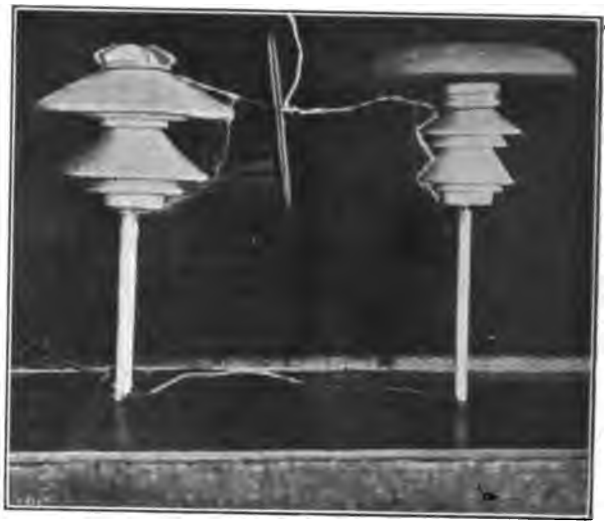


FIG. 3.—COMPARATIVE TESTS OF OLD TYPE AND SEMENZA PATENT INSULATORS.

1,600 millimeters (62 in.) per hour. The difference in size between the two insulators for the same breakdown is very clearly shown below.

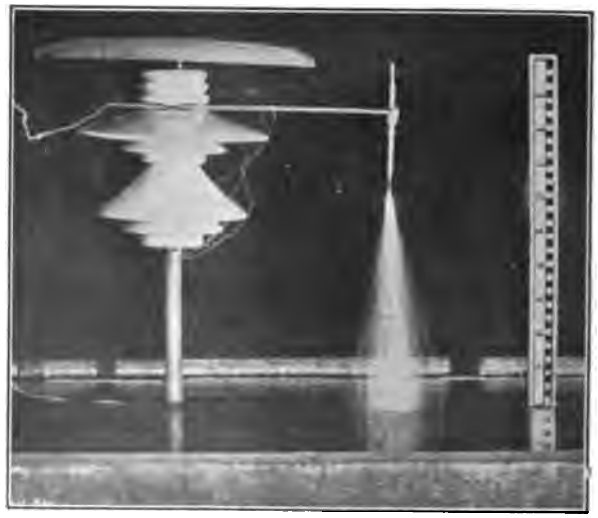


FIG. 4.—SEMENZA PATENT INSULATOR UNDER 122,000-VOLT TEST.

Fig. 4 shows the new Semenza insulator under an electric pressure of 122,000 volts, the test being taken with the insulator dry. The length of the discharge which takes place between the needle

point and the surface of the alkaline bath is shown by the scale, which also serves to give some idea of the dimensions of the new insulator.

It is claimed that tests with a driving rain do not make any difference in the remarkable results shown by these experiments, and if such difficulty were anticipated, the size of the umbrella could be correspondingly increased with practically no difference in price.

The manufacturers state that they cannot at present give the exact dimensions of an insulator of the old style corresponding to that represented in fig. 4, as this insulator will resist a strain of 111, 000 volts under a rainfall of 1,200 millimeters (46 in.) per hour, which in the old type, they claim, has not yet been manufactured. They also point out that if the difficulties of manufacturing such an insulator could be overcome, it would have at least double the price of the Semenza patent insulator.

The saving in price between the Semenza insulator and one of the old type is stated to be between 30 and 40 per cent. for an equally safe installation for working pressures between 35,000 and 50,000 volts, and for working pressures of 80,000 to 90,000 volts, a saving of 50 per cent. is claimed.

Reference to fig. 3 will show that the surface of the insulator is covered with moisture, and that drops of water actually collect there; tests, however, seem to indicate that the good results are not affected by heavy films of moisture.

Signor Semenza has stated that he considers one of the reasons for the remarkable results achieved to be that the wire is at no point in touch with a stream of water running over the surface of one of the effective petticoats of the insulator, and it might, perhaps, be said that the important effect of the insulator seems to be that the live wire and the effective surface of the upper petticoat are screened from "live water."

The shape of the umbrella might, of course, be slightly altered if necessary to cause the stream of water to run off on either side of the insulator entirely clear of the live wire.

It is interesting to note that tests so far undertaken seem to indicate that with this type of insulator the breakdown point under the heaviest rain storms is only in the neighborhood of 90 per cent. when wet, as compared with the breakdown when dry.

In conclusion, it should be stated that this insulator is now being placed on actual transmission lines, and the results obtained in practical operation should be awaited with great interest by those engaged in transmission line problems. — *London Elec. Rev.*

CURRENT IDEAS

For Furnishing More Light, Heat and Power from Central Stations.

Organization and Conduct of a New Business Department Suitable for Central Stations in Cities of 50,000 Population and Under.

By Charles Nathan Jackson.

I have always lived in the small city of "C," a town of about thirty thousand inhabitants, in Central Ohio. I have been in the banking business for several years, and was interested, to a certain extent, in our local electric light plant. In course of time, however, I purchased the entire property. The former officers of the company had always been satisfied to let well enough alone, and, as the plant was paying a small dividend, they were not very aggressive. I determined to see if, by increasing the business, I could increase the net earnings of the property.

We had a total generating capacity of 600 KW. and did not do the municipal lighting. The revenue was about thirty thousand dollars per year, and the plant was loaded to its utmost capacity about

5 o'clock in the December afternoons. The manager in charge was a very capable operating man and had several years of experience at operating plants. He was drawing a salary of two thousand dollars per year, but did not seem to know much about hustling the business. When I asked him what we had better do to increase the revenues, he said, "hire a solicitor." We finally secured a young man who had sold electricity in another town, and started him to work and then began to make plans for increasing the capacity of the plant. We were charging ten cents per KW. Hr. and the young man had not been at work very long before he secured a contract for a wholesale house that would use about twenty-five arc-lamps. He also got contracts for several factories, and I began to think that there was a good prospect for his building up quite a business. However, I did not see any increase in the receipts, but the manager told me to wait until next winter, and all these new customers would then be using the light. Of course we could not expect much in the summer, as they did not need it. Gas was selling at a dollar a thousand cubic feet, and a walk through the business district at night showed all the saloons, drug stores, restaurants and hotels using gas. Upon inquiry, I found that the price of electric light to such consumers was about three times the cost of gas, and, of course, they could not afford to pay the difference. The solicitor's business soon began to drop off and in a few months his orders were very few and far between. He merely said that he had secured every customer that he could and could not possibly get any more.

In other cities I have seen the electric light company light all the saloons, drug stores, etc., and wondered why we could not do it. So I began to look around and see if I could not find a man who could get the business. One day, in answer to one of my letters, Mr. Johnson, a man of about thirty-five years, called to see me, and in answer to my question as to what he could do, he replied that he did not know, but that if I would give him a guide and a right to ask a few questions, he could soon tell me. I did so, and the next day he returned and said, "I find that you have loaded your plant down with 'short burners.' About the only revenue you get is on the peak in the winter. You asked me how I could increase your net profits, and I will say that I can increase your net profits from twenty to thirty thousand dollars per year, and you need not purchase any more machinery." I replied that I did not see how that was possible, as we could not raise our prices. He said that he would *cut* them to some customers and *raise* undesirable ones. "For example, you have a commercial light and power load of 600 KW. on the peak, or a revenue of fifty dollars per year, per KW., demanded on the peak. Now there are a great many concerns, such as saloons, drug stores, restaurants, hotels and other 'long burners' that you ask to pay, at your present ten-cent rate, $200 per year per KW. demanded, which is much too high; imagine a drug store having forty sixteen C. P. lamps paying you $400 per year; their gas bills are not over $150 per year, but you will let a wholesale store that closes at 5:30 burn forty sixteen C. P. lamps and only pay you $50 per year, and they cost you nearly as much as the drug store. All of your fixed expenses are the same for both, but the drug store uses about 4000 KW. Hrs. and the wholesale store 500 KW. Hrs. As your coal bill is not over one-half cent per KW. Hr., you can see the drug store would cost, for coal, $20; the wholesale house $2.50. So you are either making a very large profit on one or losing a lot on the other."

I could readily see that this argument was correct, and asked him how he would go about it to produce results. He replied that the town was not large enough for him to spend his entire time with us, but that he had in training several bright salesmen, any one of whom was capable of going into the town and working up the business under his supervision. Of course it would often times be necessary for him to help the solicitor on some big contract, and that he would charge me $1800 per year for the services of the solicitor, and for his own services he would ask 25 per cent. of the increased profits during the first two years; after that he would probably not be needed, as things would be running so nicely that the solicitor would be able to go it alone.

His desire to back up his ability with such a proposition made me feel safe in accepting it at once. He at once came on the ground to give us a start, and first got a friend of our company to agitate a rate ordinance, which was passed. It prohibited a charge in excess of 50 cents per month, per sixteen C. P. lamp to customers using light not over ten hours per day. The "long burners," of course, were pleased and boosted it along. The "short burners" never dreamed that it would effect

them and said nothing. He then sent for the solicitor, who was instructed to charge a flat rate of $5.00 per month per KW. demanded and an extra charge of 2 cents per KW. Hr. to all light customers, except residences, who were to pay 10 cents per KW. Hr., $1.00 minimum. Lodge rooms, churches and hotels were to receive a special rate. The solicitor had no trouble in securing contracts with all the "long burners," and at the same time kept an eye open for unprofitable "short burners" and raised their price to the new rate. The wholesale houses, when asked to pay $10 per month, plus 2 cents per KW. Hr., threw up their hands in horror and said that they would not stand for any such "holdup," so they put in gas.

I am going to start a strong campaign on residence lighting, churches and lodge rooms, which commence to burn at 5 o'clock and get heavier as the other load goes off. He engaged two bright young fellows and started them after residence contracts at the old price of 10 cents per KW. Hr. They would turn the names of all progressive customers over to a stenographer, who would mail them a series of letters and advertising matter on electricity for home use. In that manner they would get from two to four contracts per day. All that time the solicitor was getting all the churches and lodge rooms he could at a 6-cent rate. It was not long before I could see a change in the load curve. It began to fill out after 6 o'clock. He was not satisfied with that and would get after more power business. I replied that factories did not stop work until 5:30, so their load would be on the peak. He said that large factories are on the peak, but small shops are not. He had studied their load and found that a load curve from a power circuit handling a great many large and small customers showed a load curve during December that began to drop off at 4 o'clock and reached zero at 6, and at 5 o'clock it was only 50 per cent. of the total load, and that there were several large factories which he knew were on at 5 o'clock; consequently it must have been the small shops that began to quit at 4 o'clock and were practically all through at 5.

He began to push power business at 3 cents to large and small customers alike. As there was no firm in town that handled motors, we sold them to our customers at cost. Such a low price on power secured a great many small power customers and a few large ones. He was gradually filling up the "valley" in the load curve, and our receipts in March were $5000, which made me feel pretty good. About that time a big cold storage plant was being built, and Johnson went after the business, quoting a 2-cent rate. He told me that they would require 100 H. P. about 600 Hrs. per year, which at 2 cents per K. W. Hr. would give us a revenue of $9000, of which about 75 per cent. was clear profit. I had so much confidence in Johnson that I knew he was right, but I had to ask how the profit could be so much and how he could carry the increased load. "Nothing easier," he said. "They agree *not* to use power after 4 P. M. in November, December and January, so the only time they come near our full load is Saturday night in the summer time, and then our load is never more than 400 KW. Regarding the 75 per cent. profit, I am going to let you answer that. Do you have to put in any more machinery to carry the load?" I replied "No." "Do you require any more men to run your plant?" I said "No." "Then isn't coal the only added expense, and does it cost you over one-half cent per KW. Hr.?" I took off my hat to him. I could see his 75 per cent. profit.

When summer came, our receipts held up to about $4000 per month. All the stores were paying their "flat rate." The power customers were paying more than they did in the winter, the refrigerating plant was paying us nearly a thousand dollars per month, and I began to see visions of a good paying property.

Johnson had an office system that was very thorough and yet very simple. He first bought one section (two drawers) of a verticle filing cabinet. The folders were numbered from "one" up. He had another drawer in which he kept his 3 x 5 index cards. When a new contract came in, a work order was issued in quadruplicate (two heavy copies and two tissues), one tissue was put in the customer's folder and the two heavy copies and the other tissue went to the operating manager, who kept the tissue and passed the two heavy copies to the line foreman and the meter foreman. The operating manager's tissue was kept on his desk, so that he could see what orders were in the hands of the men. When the men returned, their copies marked "completed," he destroyed his tissue and passed the order back to Johnson, who passed them, with the contract to the bookkeeper, who would enter customer's name and rate on the ledger, and then would pass them back to Johnson, who filed them in the customer's folder. He issued work orders for meter

tests, complaints on service, etc., to the operating department in the same way, always filing his tissues at once, so, at any time, a glance in the folder would tell what the last move was. All prospective customers had a folder. After a visit, where anything of importance was said or done, he would dictate a "report" and file it. He also had a small desk tray, which he called the "tickler." One set of guides were for the twelve months, and one set for the thirty-one days. I have seen him dictate a report on a prospective customer, saying that if "Jones & Co. renewed their lease December 1st they would be glad to accept our proposition of April 15th." He would then drop a 3 x 5 tickler card in the tickler, for about December 1st, calling attention to report of April 15th, on Jones & Co. He never tried to remember the slightest thing regarding any deal. If it were "up to the other party" he paid no attention to it and never gave it another thought. If it were "up to him" he would put in a tickler that would come up, say in ten days, asking if "Davis & Co. had answered June 12th," or, "had P. C. Stewart sent him plans as per May 29th."

One day I asked him how a certain big power deal was progressing. He looked in the folder and found that the last thing done was a letter confirming a verbal quotation. It was signed by the solicitor, and we, to test the solicitor's system, looked in the tickler to see if he was taking care of it. We found a tickler dated eight days from the date on the letter, asking if the Iron Works have answered May 17th. He taught his solicitors never to use their memory, but to keep the system in first-class shape. He said that a good man could solicit, at one time, fifty large deals, whose business would run from three thousand to twenty thousand dollars per year, and can tell any detail of any one of them in a very few minutes. After a call on a prospective customer, he should decide when he would call again, make his notes and then forget that such a deal is on.

There were about fifteen deals which he gave his personal attention in our town. I have seen him come into the office after a week's absence, look at a small memo. book and say, "I must see Brown & Co. this trip." I would ask him, "How about the others?" He knew no "others." He knew only those that turned up for that trip, and under no circumstances would he go near any other deal.

He trained his men *never* to say anything while on a deal until they got all the information they could, then to go away and "form a plan of campaign" and, when they got a plan that looked good to them, "go ahead and work it."

At the end of the second year the results showed that our revenue was $62,000 per year and about the only increase in operating expenses was for coal. I was very glad to pay him according to our agreement and insisted on retaining him at a salary of $1200 per year in an advisory capacity only.

Our two largest hotels looked as dark and gloomy as they could, and the owners would not install any more lamps. The solicitor, by making a special rate for a few months, lighted one hotel until it made the other look like a dungeon. That made the ownership "dungeon" sit up and take notice. As soon as the dungeon was well lighted and a contract was secured, the solicitor had no trouble in securing a contract with the other.

We made a special rate of 3 cents per KW. Hr. with a minimum of 5 cents per month per two C. P. lamp, on signs, the customers agreeing not to light them before 5:30. As they came on after 5 o'clock peak, our cost was only one-half cent per KW. As the sign load would give us a revenue of nearly $60 per year per KW., we considered it the best kind of business. Johnson showed me that if we charged 6 cents for sign lighting, we would, as a rule, not get over $60 per KW. per year, and as they would light them at 4:30 during the holidays, and be on our peak, there would be no profit to speak of, while at the 3-cent rate, with the 5:30 start, it was nearly all profit.

The Gas Company, seeing their "long burners" leaving them, and, in return getting our outcasts (short burners), began a very aggressive campaign and offered all sorts of cut-rate propositions. Johnson told me to call upon their manager and tell him that if he did not quit that kind of warfare we would give him a "dig" that would hurt. You can imagine what that manager said to me. After I reported the result of my talk with the gas manager to Johnson, he said that we would advertise complete electric cooking outfits for $80 on time payments, and would sell current for them at 2 cents per KW. Hr. By advertising, we had no trouble in assuring the public that it was cheaper, cooler, cleaner and more healthful than gas, and we put out fifty sets in two weeks. The gas manager came to me and asked me how much longer we were going to run that offer. I replied "forever" and he went away declaring that we would go into

bankruptcy if we continued at such a price. Johnson contended that we were making a good profit on it at 2 cents. It is an all-day load until people begin to get their supper, the load at 5 P. M. is not worth considering and it gradually gets heavier until after 6. After we put in our new 500 KW. generator, we cannot get enough residences to fill our load curve out from 5 to 6, so the cooking load will fill in there very nicely, and only increase our expenses a little for coal. The gas manager intimated that if we would put the price up to 3 cents that he would quit cutting prices in the business district. But we were so strongly intrenched there that we thought we had better let the price remain at 2 cents, as it was a great "ad" for us.

You asked me how to organize and conduct a commercial department, and, after my experience, can safely say, hire the best commercial man in the country and let him do the rest. E. E.'s and M. E.'s are absolutely necessary in building and operating your plant, but don't expect them to be commercial men any more than you would expect your architect to manage your factory, office, bank or department store if he should build it. So far the electric light industry has paid the high salaries to the engineers and have employed young inexperienced solicitors at salaries from forty to one hundred dollars per month, to market the product from an investment of sometimes *millions*. For that reason "good salesmen" have never cared to go into the electric business and consequently today, when there is millions of business to be sold, there are very few men capable of selling it. Let me show you the difference between a "good man" and a "cheap man." You wish to develop a certain very thriving factory district, where you have to make a long run to reach it, and you must secure a certain amount of business to warrant the extension. Your "good man" secures 75 *per cent. of the business that he goes after*, your "cheap man" 30 per cent. Your "good man," therefore, makes it possible to make the run and thereby gives you a big revenue from that district, while you get none from the "cheap man's" effort. Every man that you go after and "land" is an advertisement, because, he, to show his good judgment, tells every one how nice and cheap electricity is. While the man that was solicited but not "landed" by the "cheap man" tells how *he* would not use it, as the price was too high.

I know of one case where a "cheap man," in talking to the manager of a foundry, that was under construction, let the manager calculate that one crane, one cupola blower, three rattlers, one emery wheel and one small air compressor, for shipping, would, at a 5-cent rate, cost him $8000 per year. The manager proved to the "cheap man" that it would cost that much and the manager was about to order his steam plant, when a "good man" heard of it and called to see him. When he heard the manager's story he merely said, "I know of a foundry where the conditions are identical, and, at a 5-cent rate, they only pay about $3000 per year. You put in your motors, but let the Central Station handle you for a few months, then, if your bills exceed that amount, and you still think that you can save money by installing your own plant, do so. He got the business and kept it.

Voltax.

The Electric Cable Co., of New York, with its modern and extensive factories in Bridgeport, Conn., is now placing upon the market a new and remarkable insulating material known as "Voltax."

After a series of tests made by the Electrical Testing Laboratories, of New York, and extending over a period of five years, "Voltax" showed such wonderful insulating, weather and heat-resisting qualities, to say nothing if its flexibility without cracking or breaking, that it has established itself as the most practical insulating compound known to the electrical field. The fact that this compound can be manufactured and sold for 20 per cent. less than the ordinary rubber insulation, and that its chemical and physical properties are such as to make it well suited to the most difficult situations, is bound to bring it largely to the attention and use of central station managers generally. "Voltax" having the additional powers of retaining its elasticity indefinitely, with no chemical or corrosive effect upon copper, and being unaffected by heat under 250 degrees Fahrenheit, makes it not only applicable for the insulation of outside wires, but also for the insulation of armature and field coils of motors and generators, as well as for transformers. A piece of ordinary copper wire covered with four layers of tape impregnated with "Voltax," withstood a pressure of 27,900 volts before the insulation was punctured. The four layers of tape in question measured only 84 mils in thickness. A

similar sample covered with six impregnated tapes and a dry tape, after being immersed in salt water for 72 consecutive hours, showed a resistance of 23,000 ohms, showing that salt water had no effect upon the insulating qualities of "Voltax." It is, therefore, easy to imagine the enormously high

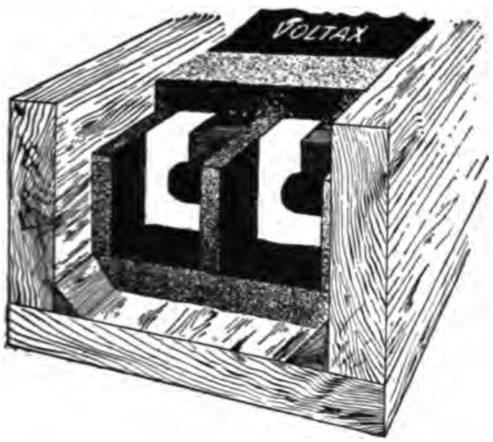


FIG. 1.

insulation resistance that can be attained by a solid wall of "Voltax" surrounding a conductor required for outside overhead or underground service.

Although the above company is in a position to furnish, and has furnished, large quantities of wire insulated with "Voltax" tape, the great field for the use of this insulating material will be found in the running of underground and submarine wires and cables, especially where high voltages are intended

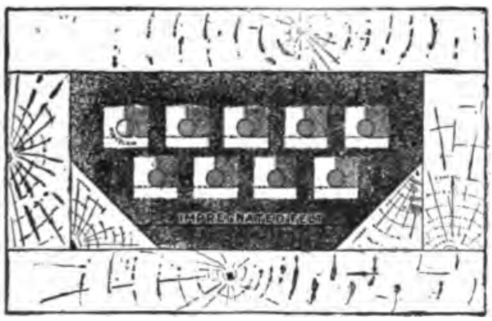


FIG. 2.

to be used. It frequently becomes necessary for a central station to carry its mains into buildings for some distance underground and, until the advent of "Voltax," a more or less expensive system of iron or clay conduits had to be adopted. By the use of "Voltax," ordinary rough wooden troughs may be constructed of just sufficient size to admit the wires, which may be not only uninsulated, but untinned, separated from each other in the trough by porcelain or glass insulators, and before the final cover is placed on the trough, it is filled with "Voltax" in a semi-liquid or plastic state which, in a short time, forms a very tough and hard though elastic insulating wall, and one which no ordinary weather conditions of heat or cold can affect.

An entire underground system of distribution from a central station or sub-station can be installed in this simple and permanent manner, thus obviating the use of iron or clay conduits and rubber

SIMPLE, PERMANENT AND INEXPENSIVE SUBWAY FOR WIRES OF ANY VOLTAGE BY USE OF WOODEN TROUGH AND VOLTAX.

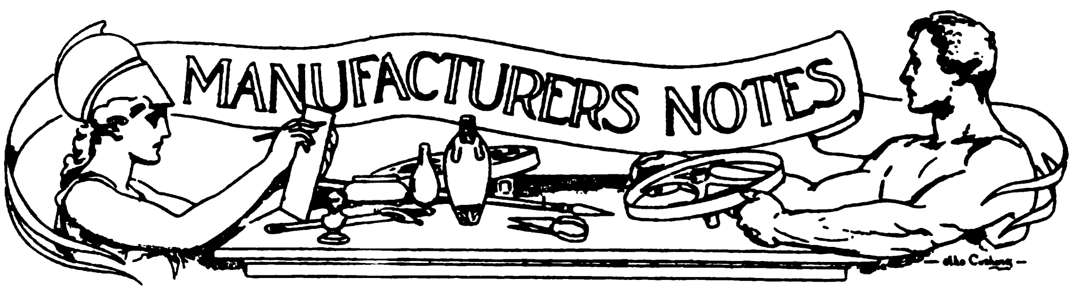
or lead insulated wires or cables necessary in that class of work.

Whenever it becomes necessary to run an extra circuit from any set of mains, the "Voltax" surrounding the wires may be melted away by use of an ordinary blow-torch, and the necessary connections made by ordinary soldered joints when the branches are of small size, or by use of the Dossert joints

which do not require the use of solder. These latter joints, after securely made, are thoroughly covered by tape to prevent "Voltax" from creeping in between the contact surfaces. After these connections are made, the hole thus made in the "Voltax" is filled up, and the cover placed in position. Figures 1 and 2 show other methods of installing an underground wiring system by the use of "Voltax" and "Voltax" impregnated felt between the carriers, which, after being placed in position and after the conductors have been laid, "Voltax" compound is poured into the trough, thus creating a solid insulating material throughout.

Whenever it becomes necessary to increase the number of conductors, it is a simple matter to remove the cover of the original trough, build up the sides of sufficient height to admit the new conductors, and repeat the process above described. Branch circuits or taps may be made to the system at any time, without interruption to the service in any way.

"Voltax" has been found, in addition to its insulating qualities, a most valuable compound for waterproofing wood and metal, and should be extensively used by electric lighting and power stations for covering the buried ends of iron or wooden poles used in supporting arc light or other distributing lines.



The Hooven-Owens-Rentschler Co., of Hamilton, Ohio, have licensed the Felton-Guilleaume, Lahmeyer Werke, Frankfort-Maine, Germany, to build the "Hamilton-Holzwarth" turbine throughout Germany.

The Felten-Guilleaume, Lahmeyer Werke Co. is one of the largest electrical concerns of Germany, with a capital of $20,000,000, and occupy the same position abroad as the General Electric Co. and Westinghouse Electric & Mfg. Co. do in America. They manufacture both water and steam turbines, wire cables, generators, motors and all classes of electrical machinery, having recently bought the control of the Escher-Wyss Co., Zürich, Switzerland, thus controlling the Zoelly Steam Syndicate of Germany.

The Felten-Guilleaume, Lahmeyer Werke Co. have taken up the manufacture of the "Hamilton-Holzwarth" turbine after a very careful investigation of the different steam turbines that have thus far been invented throughout the world, and after a series of most careful tests on this particular type of machine which were made at the University of Darmstadt. The acceptance of the turbine was made on a basis (of the "Hamilton-Holzwarth" turbine, after a series of tests), being equal or better than any turbine of the same size and speed in operation in Europe. A result of the tests referred to above will be ready for publication in a few weeks.

The Hooven-Owens-Rentschler Co., of Hamilton, Ohio, have a duplicate of this machine at their works, which has also been tested out and is ready for immediate shipment; this turbine is of the 500 k.w. size, three phase, 60 cycle, 2,300 volts, adapted for 1,800 R. P. M.

The Peerless Electric Co., of Warren, Ohio, reports business brisk in the motor line. This concern has recently furnished the new plant of the Sherman Envelope Co., Worcester, Mass., with sixty-two individual motors, making a model equipment. The Gospel Trumpet, Anderson, Ind., is putting in 23 Peerless motors and a large A. C-D. C. motor generator set. Hinde & Dauch Paper Co., Sandusky, Ohio, are installing 66 motors and sev-

eral more at their Hoboken plant. A contract has just been taken by the Peerless Electric Co., to equip the machinery of the Manual Training School at Greenville, Ohio, with variable speed individual motors. Peerless motors are being placed in the new Sinton Hotel at Cincinnati, to operate the ventilating fans and pumps. Among other jobs just being completed are individual motors for the Cadillac Printing Co., Detroit; *Elgin Dairy Report,* Elgin, Ill.; Grover Bros., Newark, N. J.

The General Electric Company has recently developed a line of knife-blade switches to be known as "D-12" lever switches which meet exactly the requirements of this class of electrical apparatus. In the first place the switch is of simple construction. Sweated joints have been eliminated so far as practicable, and such joints as are sweated are reinforced by other means of fastening. Similar parts of switches of the same capacity are made interchangeable, and the workmanship throughout is of a high grade.

Every detail in these switches is carefully worked out. The cross bars are made of selected black fiber secured firmly to the blade, while the handles are made of hard wood stained black and polished, and firmly attached to the cross bars by heavy studs and insulated nuts. In order to provide for very

low rise in temperature, the contact clips are generously proportioned from hard drawn spring copper securely pinned and soldered into the clip blocks, and the hinge clips are provided with large and substantial spring washers which serve to maintain good contact by compensating the slight wear incident to long continued use. These spring washers are provided with positively locked nuts so that

contacts are prevented from working loose in the most severe service. Hard drawn copper is used in the construction of the blades.

General Electric switches of this type can be furnished, with connections either for enclosed fuses of the national electric code standard or link fuses. Single and double pole, double throw switches have off-set fuse connections, necessitating but one set of fuses. The standard switch for enclosed fuses is so arranged that when the switch is open the fuses are on the load side. This arrangement can be varied, however, and switches can be furnished so arranged that when open, the fuses will be between the switch and the service. D-12 switches are made in single, double, triple, and four-pole types.

The General Storage Battery Company with offices at 42 Broadway, New York City, N. Y., has increased its business to such an extent that it has been obliged to enlarge its present works at Boonton, N. J.

Additional generating units are being installed, and the additional switchboard equipment consists of twenty-one generator and feeder panels.

The new building which is being added will be

a structure of five stories and basement, for which a separate power station will be erected.

The Boston Edison Company had its monthly dinner and meeting on Friday evening, October 12, at which the guest and speaker of the evening was Mr. Van Rensselaer Lansingh, Engineer and General Manager of the Holophane Glass Company. Mr. Lansingh gave an informal talk on the general principles of illumination, with particular examples of different classes of lighting for houses, etc. Lantern slides were shown illustrating both good and bad features of the lighting of bedrooms, parlors, libraries, kitchens, etc. This was followed by a discussion of the merits and disadvantages of the latest forms of lamps, such as the Tungsten, Tantalum, GEM, etc., and the necessity of using these lamps in the best possible ways, especially with the proper and correct reflectors, especially designed for them. The lecture wound up with a discussion and criticism of the existing lighting of the desks and with the offer of Mr. Hale, the general agent of the company, to authorize the funds to modernize the present installation.

A real innovation in attachment plugs is that recently placed on the market by the Sarco Company, 906 Sixth Ave., New York, which they term the Sarco Swivel, Separable, Attachment Plug.

This attachment plug, in addition to being separable, is also swivel, and at the same time will pull apart at any angle, thereby having the advantages of various plugs now on the market, ALL IN ONE. The accompanying illustration shows the plug open.

By an ingenious locking device in the bottom part

of the plug, the top part is gripped firmly and at the same time has a ball-bearing and revolving contact.

The heavy circular band in the top plug makes contact with two heavy phosphor bronze spring contacts in the bottom plug, making one pole, while the center stud in the top locks into the center of the bottom plug, thereby giving more contact surface to this plug than to any other swivel plug made.

Should the cord attached to the plug become twisted, it is not necessary to separate the plug, but simply revolve the top part, as the top part swivels in either direction, and yet at the same time should the cord attached be accidentally struck oi strained, the top part would become separated from the bottom part, thereby automatically disconnecting the circuit.

Dossert & Company, of New York, announce that they have received notice from their representative in Milan, Italy, that the Dossert Solderless Connectors exhibited at the University Exhibition, Milan, 1906, were awarded a gold medal.

The Ventura County Power Co., of Ventura, California, will install a new power station at Oxnard, the equipment for which has recently been contracted with the Allis-Chalmers Company, of Milwaukee.

The outfit will comprise a standard 300-kw. Allis-Chalmers engine type generator, designed to operate at 125 R. P. M., 50 cycles, 3 phase and 2,300 volts. The generator will be separately excited and will be driven by a Reynolds-Corliss tandem compound condensing engine of the heavy duty type, 16" and 32" x 36" and operating at a speed of 125 R. P. M. The engine is to be fitted with a complete electric synchronizing device and will have valves in the heads of both cylinders.

"Modern Steam Engineering in Theory and Practice," is the title of a new and most practical book just published by the Norman W. Henley Publishing Co., of 132 Nassau street. This book has been specially prepared for the use of central station managers and engineers who desire the latest, most reliable and most practical information on the subject of steam engines and boilers.

Boiler conditions from the fuel to the chimney and from cold water to live steam, including boiler enonomics, boiler settings and their connections, with all the necessary illustrations and tables, are thoroughly dealt with.

Every type of steam engine now in common use is described, together with the most minute details of their operation, including the steam turbine. The chapters on electric lighting and power, which form a valuable and important part of this work, were prepared by Mr. Newton Harrison, of the editorial staff of THE CENTRAL STATION. The chapters on the engines and boilers above described are by Mr. Gardner D. Hiscox. The book consists of 450 pages, with over 400 detailed engravings especially made for this work, which will be sent, postpaid, to any address by the publishers upon receipt of $3.00.

Norman Miner has joined the forces of The Bates Advertising Company to represent them in the Central Station Advertising Department.

Mr. Miner has had experience in this field and central station managers will find him fully competent to lay out advertising plans.

W. L. Hedenberg Publishing Co., of 136 Liberty street, New York City, now have ready for delivery their new book entitled "Practical Alternating Currents and Power Transmission," written by Newton Harrison.

This volume was written with the purpose of presenting alternating current practice without mathematical analysis. The great drawback to the average practical electrician in other works of this nature is the profuse use of higher mathematics in connection with alternating current theory and practice. This volume, as stated, presents certain dominant facts and principles in alternating current engineering in a clear, simple and comprehensive style. The single-phase, two and three phase currents are clearly explained and fully illustrated by diagrams. The book consists of 375 pages fully illustrated by diagrams, and will be sent, postpaid by the publishers, to any address upon receipt of the price, which is $2.50.

For wedding and anniversary gifts, the beautiful electric and gas table lamps, as exhibited by McKenney & Waterbury Co., at their showrooms, 181 Franklin, corner Congress Sts., Boston, Mass., over three hundred ideal styles, fitted with art shades, varying in price from $3.00 to $300.00 each.

The Cooper Hewitt Mercury Vapor Lamp for Industrial Lighting.

The Cooper Hewitt Mercury Vapor Lamp, invented by Mr. Peter Cooper Hewitt, as the outcome of a long study of electrical vacuum phenomena, and quickly recognized throughout the scientific world as the most efficient illuminant known, has come into a wide commercial prominence in the past year in many interesting and important installations in the field of industrial lighting. Placed upon the market in 1903, the records of its performance in installation, dating back to its introduction, have more than realized the original guarantees of its reliability and economies, and the popular endorsement of the highly satisfactory quality of its light after long trial in these early installations has further encouraged its adoption in various new applications. Recent improvements in design and construction have increased its general utility, and the perfection of a new type of lamp adapted to prac-

tically all alternating current lighting circuits has doubled the field of its possible usefulness.

When the Cooper Hewitt Electric Company first put the mercury vapor lamp on the market, its interesting scientific features and the attention everywhere attracted by the novelty of its bright light overshadowed for a time commercial recognition of its unrivaled industrial value. With the reputation of the lamp as the cheapest form of industrial lighting now firmly established, however, and a rapidly increasing demand created by the facts and figures of its service to date, it is to-day being installed in large numbers in factories and workrooms of all sorts, in several hundred standards styles designed to meet any requirement of commercial lighting systems.

The records of the performance to date of mercury lamps installed in 1904 and 1905 have demonstrated that the operating life of Cooper Hewitt tubes exceeds 5,000 hours in numerous instances. The New York Transportation Company recently renewed four tubes which had been operated over 10,000 hours each, and three of them were in fair operating condition when returned to the factory, but somewhat blackened from long service. As the only cost of maintenance in mercury lighting is for tube renewals—about one-third the original cost of the complete lamp—the demonstrated long life of the tube gives a new importance to the figures of its high efficiency. The useful life of the incandescent is but a comparatively small fraction of the demonstrated life of the mercury tube. The radiant heat from mercury lamps is in proportion to lighting capacity a very small part of that given off by incandescent globes or arc lamps, and this high efficiency, which means an all-important saving in current consumption, has incidentally meant also a material reduction in the temperature of workrooms in many installations in which the heat from former lighting methods had been very noticeable. The operating economy is well established—a candlepower of light for a current consumption of from .55 to .64 watt, proportionately one-sixth the current required by an incandescent globe, one-third that required by an enclosed arc, and one-half that required by an open arc.

In the growth of Cooper Hewitt lighting, considerable attention is being attracted to the peculiar merits of its illumination—the even diffusion of light from a luminous surface of great extent, which prevents the formation of sharply defined lights and shadows or the contraction of the pupil of the eye caused by the concentrated luminous points of other lights; and the freedom of the mercury spectrum from red rays; attributed physiologically as the chief cause of eye fatigue in work under other artificial illuminants. Light is emitted in even intensity from every portion of the tubes, and there are no dazzling or bright moving spots. The distortion of some color values under the mercury lamp because of the absence of red rays is a matter of no consequence in the bigger part of industrial lighting, where the accurate determination of natural color values is not necessary, and the advantages of a pleasant soft illumination less fatiguing to the eye than any other light except the perfectly blended white of the sun's rays are highly appreciated by all whose labor requires close application. All artificial lights distort color values more or less. The mercury light, its advocates assert, is the only one in which the spectrum is deficient only in the rays undesirable in a light to work by.

The Cooper Hewitt lamp has been extensively adopted during the past two years in large machine shops and foundries, where the saving effected in current consumption has been very great; in business offices, in which the superior working quality of its light has dictated its use, apart from the consideration of its economy; in the press and composing rooms of many of the largest publishing houses in America, where the disadvantages of wiring around machinery are avoided by its use; in railroad repair shops; in drafting rooms; in pier sheds and freight houses; in textile mills, where the searching character of its light is of special value; in automobile garages and shops; in piano and organ factories, leather and paper mills, glass and rubber factories, copper and sugar refineries, hat factories, navy yards, and wood-working plants; and in many other industries in which its illuminating value and economy have peculiarly recommended it.

Among prominent recent installations are those at the enlarged Newark works of the Westinghouse Electric and Manufacturing Company, where 470 lamps are in use; at the new model factory of the J. L. Mott Iron Works, at Trenton, equipped with 113 lamps; at the new Baring Cross shops of the St. Louis, Iron Mountain and Southern Railroad, at Argenta, Arkansas, equipped with 105 lamps, and at the new Attica works of the Westinghouse Machine Company, where 86 lamps are used. Five of the largest river piers in New York are lighted by

them. All the United States Government currency and internal revenue stamps are printed under their light in the Bureau of Engraving and Printing at Washington, and the Automobile Club of America will use 96 lamps in its new garage building in New York.

Other interesting installations are the lighting of the presses and make-up tables in the new building of the New York *Times,* with 48 lamps; of the offices and press rooms of the Butterick Publishing Company, with 120 lamps; and of the polishing and action departments of the large new piano works of William Knabe and Son, Baltimore.

Notable examples of office lighting are to be seen also at the Washington Post-office, where 30 lamps, requiring 105 amperes in all, are in use in the high-vaulted mailing room, 100 by 200 feet, on the ground floor, in the place of 1,000 incandescent globes requiring 500 amperes with which the room was formerly lighted; at the New York Post-Office, where 53 lamps are in service in the carriers' and foreign money order departments; and at the New York auditing offices of the American Tobacco Company, which lights rooms in which several hundred bookkeepers are employed with 48 lamps.

Nernst Lamps for the New York Terminal of the New York, Pennsylvania and Long Island Railroad Company.

In these days of vast engineering undertakings probably none has presented more difficulties, or been more interesting to the architect and engineer, than the design of the New York Terminal with its tunnels, for the New York, Pennsylvania and Long Island Railroad.

This building is of such magnitude that it can easily accommodate a traveling population equivalent to a large city, and it is obvious that the equipment for the various services required, independent of the transportation question, should present many interesting problems, not the least being the choice of an economical lighting service.

The unusual proportions of the rooms to be lighted, the long hours of burning and the continuity of the service, made it necessary to investigate all systems thoroughly and impartially, to tabulate the results and then select the system that approached nearest to the specific requirements.

After a careful and exhaustive study of all commercial systems, the engineers have decided to use the Nernst lamp.

The characteristics of this lamp are admirably adapted to fill the requirements of illuminating such a building, on account of the graded units of the lamp, giving uniformity of color; the color quality of the light; its steadiness; its distribution and its economy in maintenance and operation.

The last two items are very carefully scrutinized by a railroad corporation, and other things being equal, they usually decide the question.

Financial considerations, however, did not govern entirely in this case, and the conception of the architect was given due consideration, as the choice of an unsuitable lighting scheme would have seriously marred the interior architectural beauty of such a magnificent building.

Here, again, the Nernst lamp had the advantage, and by using the inverted lamp the rays will be thrown upward, giving a perfectly diffused and steady light of pleasing color and low intensity, so desirable in lighting high interiors.

It is doubtful if there is another room in the country that has the proportions of this main waiting room, which is approximately one hundred (100) feet wide, three hundred (300) feet long and one hundred and sixty-seven (167) feet high. It is difficult for the imagination to picture such a room.

The building itself is approximately four hundred and fifty (450) feet wide, eight hundred (800) feet long and one hundred (100) feet high, and is divided into waiting rooms, dining rooms, arcades with shops, offices for railroad officials, baggage rooms, driveways, a concourse, train platforms, etc.

There are also to be lighted several miles of tunnels and approaches, and large terminal yards, for which the Nernst series lamp is admirably adapted.

It will be seen from the above list that every variety of lighting service is called for, and the predetermination of the energy required was the first problem to settle. On account of the economy of the Nernst lamp, the plant required will be remarkably small, about twenty thousand (20,000) glower units being specified.

It was recognized that in order to have the large rooms satisfactorily lighted, the entire volume should be uniformly illuminated, and inverted lamps have been so located as to produce these results.

THE CENTRAL STATION

DEVOTED EXCLUSIVELY TO THE INTERESTS OF ELECTRIC LIGHTING AND POWER STATIONS.

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Central Station Light, Heat and Power Principles

BY NEWTON HARRISON

Single Phase Power.—That which is termed single phase power, belongs to a field distinct in many respects, from either the two or three phase systems of power supply in vogue. The reason for this is evident, in a review of the saving accomplished through greater simplicity in the operating parts, as well as the actual reduction in their number. For instance, in single phase service the elements necessary are as follows:

1st. Alternator, driven by steam or gas engine, with its necessary power supply (excepting water) in the way of a boiler or a gas producer, which means coal in either case.

2nd. The switchboard with its equipment for single phase work of this character.

3rd. The step up and step down static transformers.

4th. The line, poles, etc.

These items, numbering four in all, may be still further elaborated, but not to the extent of introducing any essential elements beyond those above presented. On the other hand, a two or three phase system means complexities, which cannot be disregarded because of the unique nature of the system as a whole, namely, that of projecting two or three individual currents through the conductors of equal power, an interval of time apart. The two or three phase systems are represented by the following items:

1st. Alternator, driven by steam or gas engine, with its necessary power supply (excepting water) in the way of a boiler or gas producer, which means coal in either case.

2nd. The switchboard with its equipment for two or three phase, as the case may be.

3rd. Static step up and step down transformers

4th. A high tension sub-station switchboard.

5th. A high tension two or three phase transmission line.

6th. One or more rotary converters.

These items do not include another switchboard for direct current, or a storage battery system, as might be necessary where the power is used for street railroading. As a noted engineer has put it, "none of these links are bad in themselves, but it must be admitted, that there is a greater danger of

interruption of service, and a greater opportunity for defects, in the greater than the less number of parts."

First Cost for Installation. From a financial standpoint, there is little or no question as to the advantage of a simple over a complex system. In the cases presented, the cost of the single phase installation is considerably lower than that of the multiphase with which it is contrasted. The vital point in connection with any proposed system, is that of first cost and applicability, to which can be added that of efficiency and durability. Where a railway system is being promulgated with heavy traffic in prospect, over a distance of between 50 and 100 miles, particularly if local as well as through trains are to be operated, the sub-stations supplying power would necessarily have to be closely installed, at a consequent cost that would hardly meet with approval, in an instance where the power does not remain alternating in character.

Sub-Stations and Single-Phase Current. In that case where the sub-stations supply unusual draughts of power at periodic intervals, it becomes evident, that the stations must be made abnormally large, to adequately receive the load. This involves the heavy and prohibitive expense attached to installation of this kind. The matter may be summed up as follows. That in street railway work, with two and three phase currents, with local and through traffic (sketch No. 1), the nearness, and therefore the number, and the extra size of the stations, is a part of the concomitant expense. This may be greatly relieved by a return to a single-phase system, by which the sub-stations disappear (sketch No. 2), and the expenditure in initiating the plant brought down to a percentage of the first cost the other way

Operating Charges. In speaking of operating charges, and referring to the use of single-phase current in street railway work, Mr. G. B. Lamme made the following statement: "Coming now to the operating charges, it is noted that the single-phase alternating current system eliminates at once all the labor and other expenses connected with sub-station operation, and it is, of course, relieved likewise from *the heavy fixed charge* (sketch No. 3), due to investment in those stations. It is further relieved of the constant losses of transformation, and of the loss due to the very considerable drop in the secondary distributing system. This means a saving in power output, averaging at least *ten per cent.*, this being, if anything, an under, rather than an overstatement of the facts." The operating charges from this standpoint, belong to a category, more controllable in a sense, than those found in connection with other alternating current systems.

Where the Saving Is Found. Some figures which have been given by Mr. Clement F. Street, before the Western Railway Club, show items of great interest in connection with the use of electricity in general, for railroading. He says, "A saving is practically shown in all departments. Fuel charges are greatly decreased, power is more cheaply obtained, terminal costs are reduced, the labor item is cut down, and a very great saving is obtained in the maintenance of equipment."

The figures supplied are those obtained from 20 railways, representing 7,684 motor cars, aggregating 157,059,486 car miles. The cost of maintenance including heaters and lights per motor car was $107.00 per annum. In comparison with this, the cost of steam-driven cars of the passenger type represented a cost of about three times as much or over $300.00 per car per annum. To complete the comparison it may be stated, that the cost of maintenance of the electric plant complete, which of course, includes the steam department as well, averaged up $225.00 per annum, which is still one-third of the cost of maintenance of passenger cars above steam driven, and about one-eighth the cost of maintenance of a steam locomotive per annum on thirteen of the largest steam railroads in the United States. The managers of elevated roads have found, particularly in New York City, that the substitution of electricity for steam (sketch No. 4), was followed by a reduction in the total operating expenses of from 13.2 cents per mile to 9.5 cents per car mile or 28 per cent. These facts are of interest and instruction in showing the advantage of the change irrespective of the character of the electrical power employed. It, therefore, applies to single, as well as to two and three phase systems.

Conductors for Single Phase Power. Central stations, and power stations supplying energy to street railway systems, do not differ as regards the use of alternating current in-so-far as the size of the conductors required for a given amount of power is concerned. Single phase circuits, whether carrying part or all of the power, must be designed with reference to the power they carry, their drop, nearness of the wires and their length. The drop experienced in a single-phase conductor is not simple, but composed of two elements; resistance of a

purely ohmic character, and that due to inductive action. The impedance, which combines these two

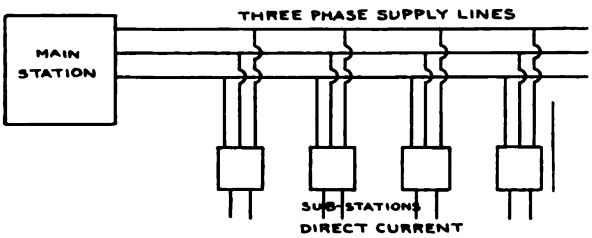


FIG. 1.—SUB-STATIONS CLOSE TOGETHER WITH HEAVY THROUGH AND LOCAL TRAFFIC.

in its title is measured as a whole in ohms. If, for instance, the drop in an alternating current circuit is 10 volts, the impedance is found by dividing the volts drop by the amperes. If the amperes in this case are 10, the impedance is equal to $10 \div 10 = 1$. The resistance of the line, however, may be only .5 of an ohm, in which case the inductive resistance is calculated from the formula for impedance. The calculation of the inductive resistance is based upon a knowledge of the inductance of the circuit, and is represented by the formula,

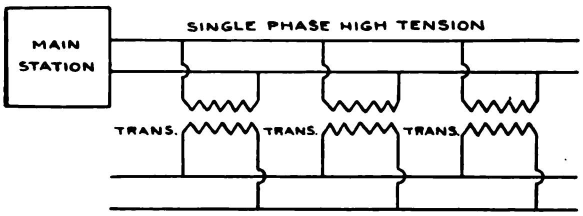


FIG. 2.—TRANSFORMERS TAKING THE PLACE OF SUB-STATIONS WITH SINGLE PHASE CURRENTS.

Inductive resistance $= 2 \times 3.1416 \times$ frequency $\times$ inductance, the inductance in this case being that of the circuit. If it is equal to 10 thousandths of a henry and the frequency is 100, the inductive resistance equals:

$$2 \times 3.1416 \times 100 \times .010 = 6.28 \text{ ohms.}$$

If the frequency is increased, the resistance will increase according to the formula, proportionately. If the inductance is increased, the resistance will increase correspondingly. The impedance formula reads as follows:

Impedance $= \sqrt{}$ (Resistance)^2 + (Inductive resistance)^2. According to this formula, the inductive resistance is equal to the following:

Inductive resistance $= \sqrt{}$ (Impedance^2 — (Resistance)^2.

It is thus evident, that the formula for impedance gives the means of ascertaining both the impedance itself and the inductive resistance. In any case where the drop in the line is known, the drop $\div$ amperes will give the impedance. The inductive resistance, or the reactance, as it is called, may be found in any case, such as that given, as follows: What is the inductive resistance of a line

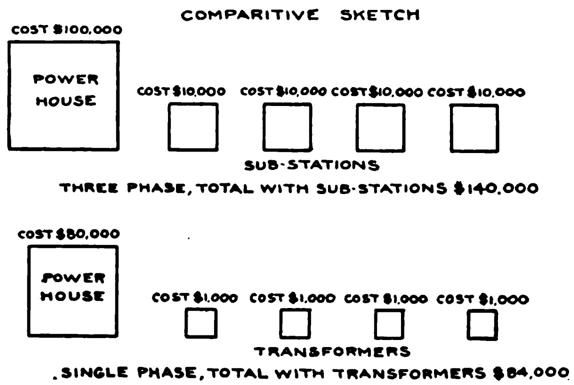


FIG. 3.—COMPARISON OF COST OF THREE PHASE AND SINGLE PHASE STATIONS OF EQUAL OUTPUT.

having 50 volts drop and carrying 10 amperes, having 2 ohms resistance?

Impedance $= 50 \div 10 = 5$; according to the formula,

Reactance $= \sqrt{}\ (5 \times 5) - (2 \times 2) = 4.58$.

If the frequency of the current is 60, then the in-

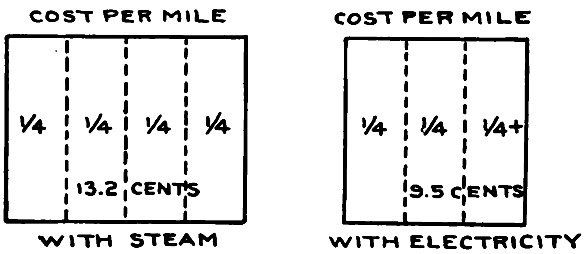


FIG. 4.—RELATIVE COST ABOUT 4 TO 3 PER CAR MILE FOR STEAM AND ELECTRICITY.

ductance of the line according to the formula must be as follows:

$$4.58 = 2 \times 3.1416 \times 60 \times \text{inductance;}$$

or inductance $= 4.58 \div (2 \times 3.1416 \times 60) =$

.0121 henry, in thousandths of a henry, this would be equal to 12 millihenrys.

Drop in Single-Phase Lines. The drop in single-phase lines is equal to the product of the current in amperes by the impedance in ohms. I C = amperes and I = impedance, then the drop is equal to emperes × impedance = C × I. The current in the line wires is generally greater, irrespective of any of the conditions noted, than that due to the power actually available. For instance, if the current is 80 amperes as consumed, then with a power factor of 80 the current in the line would be equal to the following:

Amperes in line = amperes consumed × 100 ÷ power factor

$$= 80 \times 100 \div 80 = 100$$

The actual current unused is equal to 20 amperes, but this is due to the inductance in the circuit and does not represent a loss, but simply a case of an ebb and flow caused by prevailing conditions. This is true of all alternating current circuits to a greater or less degree whether single, two or three phase.

To calculate the drop, therefore, the impedance must be known and the total flow in the conductor. The formula is, therefore, modified so as to read as follows:

$$\text{Drop} = \text{Total amperes} \times \text{impedance}$$

$$= \frac{\text{amperes used}}{\text{power factor}} \times 100 \times \text{impedance.}$$

For instance, in the case of a circuit in which the drop is to be found, but in which the impedance = 10 and the amperes 100, the drop would be equal to:

$$10 \times 100 = 1{,}000 = \text{drop;}$$

but the power factor, if about 85, would give a value greater than this, as follows:

$$\text{Drop} = \frac{100}{85} \times 100 \times 10 = 1{,}176.$$

The difference noted between 1,176 and 1,000 is due to the idle flow of current due to the inductance of the circuit which causes the lug between the electromotive force and current.

Effect of Lag on False Current. The exact coinciding of the electromotive force and current, is an indication of the absence of inductance in the circuit. The greater the degree to which inductance operates, the greater the flow of idle current. This is readily perceived from an investigation of the causes which govern the safety factor. This, it may be remembered, is due to the ratio in values between the real and the apparent power. For instance, the real power is equal to C × E cos Φ, while the apparent power equals C × E. The cos Φ is, therefore, the power factor and its value is dependent upon Φ the angle of lag between the E. M. F. and current. If $\Phi = 0°$ then cos $\Phi = 1$, in which case the power factor = 100. Thus, it is seen that the size of the conductor is in many, if not all respects, governed by the idle flow of current. If there is little or none of this, then the size of the conductor does not differ from what it would be with only direct current.

IV. MODERN CENTRAL STATIONS

The Ivry Electric Station in France

By Frank C. Perkins

In the last serial on Modern Central Stations, a description was given, with illustrations, of the two electric stations in Belgium at Antwerp and St. Gilles, both of which are equipped with horizontal tandem compound engines, which are so largely used on the Continent of Europe. A similarly equipped plant in France is of interest, and the accompanying illustration and drawing show the arrangement of the Ivry Electric Station supplying current for electric traction at Paris and Juvisy, utilizing Corliss-Dujardin triple expansion engines, each having four cylinders connected in pairs in tandem, each couple being connected at 90° to the crank shaft of generators, with heavy flywheels for aiding in the regulation.

The accompanying drawing, Fig. 1, shows an ele-

vation of this plant indicating the arrangement of the engine room, the boiler room and the coal conveying apparatus installed, while Fig. 2 shows the interior of the boiler room with the automatic coal feeding appliances. The illustration, Fig. 3, indicates a neat interior of the engine room with little decorating and a great amount of light, probably more glass being used than can be found in any other central power station for railway service or for lighting distribution in France or any other Continental country. This is a marked feature of this engine room and is well worth consideration and

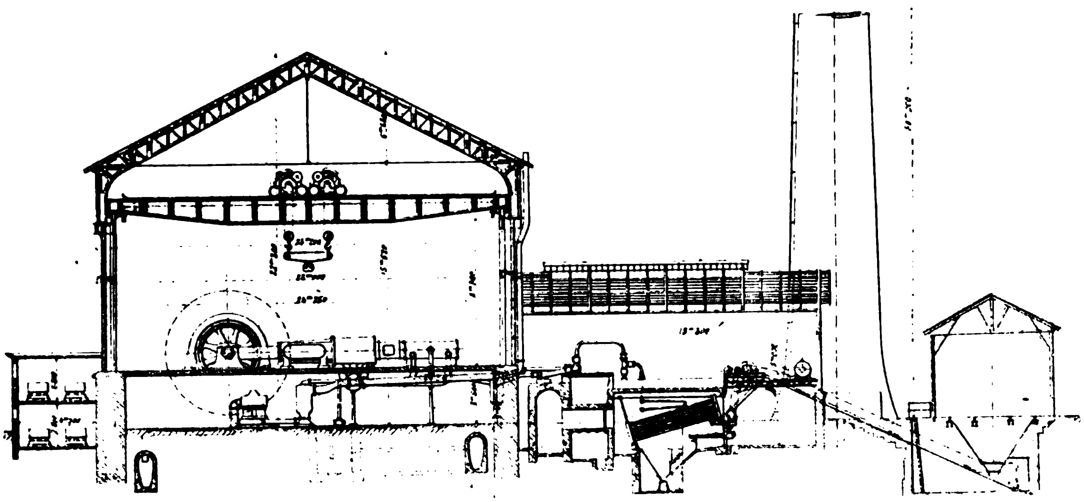


FIG. 1.—ELEVATION PLAN OF IVRY ELECTRIC LIGHT & POWER STATION, PARIS, FRANCE.

FIG. 2.—BOILER PLANT OF IVRY CENTRAL STATION.

study. The main switchboard is mounted at one end of the electrical generator room above and below the main gallery as shown in the accompanying illustration, Fig. 4, the motor generators being noted in the foreground.

The boiler plant is equipped with Babcock & Wilcox boilers, twelve in number, divided in four batteries with two Green economizers, and the coal is conveyed automatically on the Bennis system, mechanical stokers being utilized throughout.

The engine room is equipped with horizontal triple expansion engines, direct connected to alternators of the Thomson-Houston type directly coupled to the horizontal engines and supplying a three-phased current of 5,500 volts when operating at a speed of 75 r. p. m. The revolving fields of these alternators each have 40 poles, the current produced in the armature at the normal speed, and with this number of poles, being 25 periods per second. These alternators are capable of operating with an overload of 25%, supplying 1,250 kw. for two hours, and a 50% overload or 1,500 kws. for 5 minutes, without danger to the apparatus. It is stated that the variation in voltage does not exceed 10%

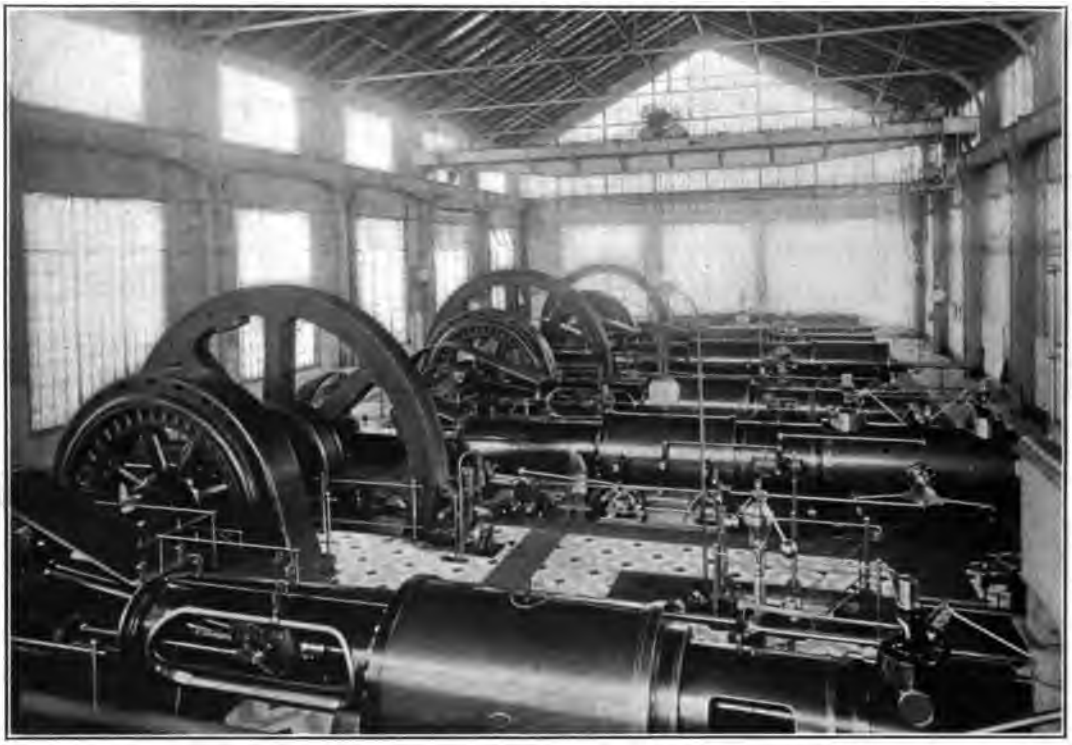


FIG. 3.—ENGINE AND GENERATOR ROOM, IVRY CENTRAL STATION.

nators, each having a capacity of 1,000 kw. These four-cylinder engines operate at a speed of 75 r. p. m., and develop normally 1500 hp., although having a maximum capacity of 2,250 horse-power. The high pressure cylinder has a diameter of 610 millimeters, and the low pressure cylinders 1.05 millimeters, while the stroke of the engine is 1.65. With an output of 1,200 to 1,500 hp. the steam consumption of these units is said to be 5 kilograms per indicated hp. The flywheels provided are 7.5 meters in diameter and weigh 33 tons.

The electrical generator equipment includes alfrom no load to full load, and with a full load the efficiency is 95%, at ¾ load 94%, and 92½% at half load, the electrical generators weigh 38 tons each and are excited by direct current machines to 125 volts, three motor generator sets being employed for this purpose of 20, 40 and 60 kws. each, the steam driven exciters being operated by vertical compound engines of from 35 to 70 hp., and the motors for the exciter sets having an output of 70 kws., being supplied with a polyphase current of 5,500 volts.

The current is transmitted to the sub-stations at

5,500 volts, where it is transformed to 370 volts three phase, and by means of rotary converters is changed to a direct current of 600 volts for distribution on the railway feeders. A storage battery consisting of 290 elements is provided for regulation and for aiding in caring for the peak of the load.

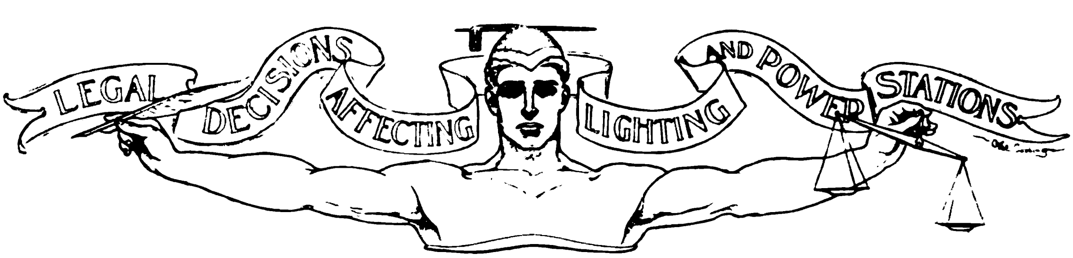
The Ivry sub-station and the Ablon sub-station each are equipped with three-phase rotary converters of 250 kw. capacity, four-pole machines being used operating at a speed of 750 revolutions per minute. There are also two hexaphase rotary converters of the 6-pole, 500 kilowatt type, operating at a speed of 500 revolutions per minute, in combination with hexaphase transformers of 525 kilowatts. These machines, like the alternators in the power station, are capable of maintaining an overload of 25% for an hour or more and 50% overload for a period of 5 minutes without difficulty.

The storage battery plant at the Austerlitz substation has a capacity of 1,100 ampere hours with a total discharge in one hour, the maximum discharge rate provided for being 1,500 amperes, while the accumulator plant at the Ablon sub-station has storage batteries of somewhat larger output, the capacity at one hour discharge being 1,500 ampere hours, with a maximum discharge rate of 2,000 amperes. By means of motor generator boosters the batteries are charged with a direct current of from 600 to 800 volts pressure.

The electric locomotives are supplied with a direct current of 500 to 600 volts and haul 150 to 200 trains ranging from a normal of 150 tons to a maximum of 350 tons with a speed up to 50 kilometers per hour. This central station and substation equipment is a fair example of modern French power plant and distribution apparatus for electric railway service.

The next serial will present the same type of engine driven central station with horizontal reciprocating engine units of German construction for lighting and power distribution as exemplified by the Elektrizitätswerk Colmar i/E, and the Elektrizitätswerk München, Germany.

FIG. 4.—SWITCHBOARD AND MOTOR-GENERATOR SETS, IVRY CENTRAL STATION.



Prepared for THE CENTRAL STATION by Colin P. Campbell, Attorney

Liability of Electric Lighting Company to Employees of Telephone Company for Shock from Defectively Insulated Wire

In this action it appears from the complaint that the plaintiff's intestate was in the employ of the defendant telephone company and on a pole owned by an electric railroad company not a party to this action. That near the top of the pole was a cross-arm supporting a wire belonging to demurrant, having inadequate insulation or insulation which was out of repair and carrying a current of electricity of 2,200 volts, dangerous to human life; that on said pole, some distance below the cross-arm, was a bracket carrying a wire of the telephone company; that the work which the intestate was set to do was to transfer the telephone wire belonging to his employer from its bracket to a cross-arm placed upon the pole at a point above demurrant's wire; that, for some reason not given, he separated demurrant's wire from its cross-arm by untying it from its pin and glass insulator; that afterward, and while engaged in retying and reattaching demurrant's wire to its pin and glass insulator, he received from it a shock of electricity which burned his hand and caused his death.

At this point we must note certain things which are not alleged and which may not be inferred from any allegations in the complaint, viz.: There is no allegation that demurrant knew, or had reason to know, that the intestate, or any other person not in its employ, would have occasion or necessity to interfere with its wire, or that the intestate so interfered with the demurrant's knowledge or consent. There is no allegation that a wire, charged as this was by a heavy current of electricity, could have been rendered harmless by any known insulation, nor is there any allegation that the plaintiff's intestate did not know of the insufficiency of the insulating material or that its defective character was not obvious. There is no allegation from which we can infer that it was solely by reason of the defective insulating material that the intestate was killed. The wires of both defendants were upon the same poles, supported by different cross-arms. They were thus brought into close proximity. From his situation it may be presumed that both defendants and their respective employees had the right to go upon the pole and do such work in respect to their respective wires as might from time to time be necessary. But this right does not imply a license or permission from one defendant to the other to remove or in any manner interfere with one another's wires. If, however, an employee of one defendant, while engaged in his duties, came by inadvertence or accident into contact with the wire of the other and was thereby injured, he may not as a matter of law be said to be negligent. Whether he exercised due care or not would be a question of fact to be determined from all the circumstances.

As to demurrant, the plaintiff's intestate was upon the pole and engaged in work upon the demurrant's wire either as a licensee or trespasser. In either event demurrant owed him no active duty. Each must be held to the exercise of reasonable care. Neither could rely upon the discharge of any active duty by the other. The plaintiff's intestate owed the duty to himself to exercise reasonable precaution. Did he exercise that care? I think the facts show that he did not.

Two causes of injury are alleged—one that the insulating material was inadequate, and the other that it was out of repair. As to the first, the fact is well known that wire employed for this purpose is a manufactured article bought and sold in the open market, and a person who uses it may not be re-

garded as negligent, unless it be alleged or proven that he knew or ought to have known its inadequacy. As to the question of repair, demurrant owed no duty to intestate to keep its wires properly insulated at the place where he received his injury. But if it did, the intestate was still charged with the exercise of reasonable care. He was a man of mature age; he was employed in connection with wires carrying electricity. If he was injured because the insulating material was not intact, such defect was as apparent to him as to the demurrant. His point of contact must have been identical with the defective place in the covering. He came in touch with it not inadvertently or from necessity, but deliberately and intentionally. He, therefore, cannot establish his freedom from negligence, unless he has a right to speculate as to whether or not the covering was defective. Can it be said that a reasonably prudent person will intentionally put himself in contact with a wire carrying a deadly current of electricity, knowing that nothing stands between himself and its deadly power save a thin and flexible layer of insulating material, liable to become impaired by exposure or erosion or abrasion, without inspecting the point of contact? I think not. It is a matter of common knowledge that the best insulation is at times and under certain conditions entirely inadequate. When a person purposely puts himself in contact with such a dangerous thing, he may not be indifferent as to whether its owner has or has not done all he ought to have done. He must be held to the decree of care that is imposed upon all persons who intentionally deal with dangerous things. In this case the intestate must be regarded as knowing the purpose for which the wire was employed, the dangerous current conveyed by it, the liability of its covering becoming impaired by use and exposure or by coming in contact with hard substances, and the uncertainty of its effective operation occasioned by dampness or other causes beyond control, and, therefore, as running the chances when he put himself in contact with it without taking any active measure to determine its actual condition.

Mangan v. Hudson River Telephone Co.

Conflicting Rights—Induction Currents—Leakage—(Continued)

In Cumberland Telegraph & Telephone Co. vs. Electric R. Co., 93 Tenn. 492; 29 S. W. 104; 27 L. R. A. 236, the conflict was between an electric railway company and a telephone company. The injury complained of arose from conduction or leakage by reason of the escape of electricity from the rails used as a return conductor into the street and interfering with the return or ground circuit of the telephone company. Plaintiff, in order to overcome this difficulty, had put in the McLeuer device, costing nearly four thousand dollars. Another injury complained of was that arising from induction. occasioned by the fact that the telephone wires parallel to trolley wires of the railroad company in destroying the parallelism of the two lines of the telephone company expended nearly one thousand dollars, and a like amount in putting up taller poles. The Court was divided upon the question, but the majority held that both the telephone company and electric railway were entitled to use the street; that neither could be compelled to be dominate and the other servient, and declared the duties of both to be to exercise their powers with a careful and prudent regard for the rights of the other and held that where the street railway company enters a street, one side of which is already occupied by telephone poles, it must place its poles in such a manner as not to interfere with those of the telephone company. But the telephone company may not recover for loss occasioned by induction resulting from the fact that the telephone lines are parallel to those of the electric company, nor may it recover for induction or leakage affecting its lines by reason of the fact that the railroad company uses the earth as a return conductor, when it is a customary method of constructing such lines; the theory being that the railroad company is entitled to use the streets and having used them in the customary manner is not liable for injury to a telephone company for prior occupancy resulting from such use.

A different result, however, was arrived at in the Texas case, in which the situation was presented of a telephone line paralleled subsequently by an electric light line with the result that the telephone line was impaired by an induced current The Court held that an injunction ought to issue to compel the removal of the electric line transmitting a current for light and power to a sufficient distance from the telephone line so that it would not interfere; and to prevent the further construction of such line in like close proximity. The decree granting this injunction and making it perpetual was affirmed by the Court of Civil Appeals in a very

brief opinion. As we have above observed light and power companies do not enjoy the same freedom with reference to placing poles and stringing wires as the street railway companies. Consequently, inasmuch as Texas holds such lines to be additional servitudes the theory upon which the Texas case was decided in which damage was not granted for induction current, namely, that both companies had the equal right to use the street, would not apply. And the Texas case cannot be considered as overruling the theory of the other case. Harrison Electric Light, Etc., Co. vs. Southwestern Telegraph, Etc., Co. (Texas), 27 S. W. Rep. 902.

In the Rutland Electric Light Co. vs. Marble City Electric Light Co., 65 Ver. 367, where two electric companies interfered by reason of the fact that the wires of one were below the wires of the other, rendering it dangerous for the employees of the company owning the taller poles to climb them, it was held that such use of the street by the latter company would be enjoined, especially where in such places the wires have by sagging and the operation of storms come in contact with one another, causing a disturbance of the lighting system of the company first upon the field. In this case the doctrine of priority of use was given full force and the court held with this theory that a subsequent company constructing a line for electric lighting might not interfere by induction or conduction with the line of another company, and that the later company might not place its lines in such a position to make it dangerous for the employees of the earlier company to reach that company's line for the purpose of repairing them.

It will thus be seen that the company first in point of time is compelled to surrender a certain amount of its privileges so to speak, in order that another company may be enabled to make use of the public thoroughfares which the company first on the ground has gained the right to occupy for its purposes. Perhaps the most fundamental proposition which may be enunciated upon this point is that the highway is primarily for purposes of public travel and that the public lacks the power to grant an exclusive franchise or right to an electric railroad or telephone company which will exclude the rights of either travelers or other corporations from like use if the public authorities subsequently deem it proper to grant a second franchise to occupy the same thoroughfare for an identical or similar purpose.

This subject has been recently extended in the New York case "Western Union Telegraph Co. v. Syracuse Light & Power Co., 178 N. Y., 325."

Where it has been held that the City of Syracuse might properly authorize the installation of two subways in the same street and might permit the last one to be placed above the first in such position that the first could not be removed without supporting the latter, the doctrine therein of exclusive franchise does not prevail, and while it is unquestionably the duty of the second company to take reasonable measures to prevent interference with the lines of the company first on the ground, nevertheless, it is equally entitled with the first to occupy the streets with its lines.

PUBLIC CONTROL; REVOCATION OF FRANCHISE.

The public authorities having the power to grant such public service corporations, as electric lighting companies, the right to occupy public ground, highways and streets with poles and wire lines; also companies the authority to grant such franchise subject to conditions expressed in the grant, controlling the exercise of the rights conveyed or to retain in general terms power to subsequently cause such rules and regulations as public conveyance or necessity may demand governing the business of the company previously granted a franchise. We may not pass this point, however, without calling attention to one of the basic principles which in a great measure controls the exercise of the power to regulate possessed by the government. This principle is found in the Constitution of the United States, copied in the Constitutions of many of the several States, and which was propounded by the late Chief Justice Marshall in the famous Dartmouth College case, known as Dartmouth College vs. Woodard, in the Fourth of Weaton, 518. The rule of the Constitution is, no State may possess any law impairing the obligation of contract. The rule of the Dartmouth College case is that a grant of a corporate franchise is a contract within the meaning and intent of this provision of the Constitution. Subsequent cases have extended the application of this doctrine to lesser governing bodies than the State upon the theory that such lesser governing bodies are but agents of the State and consequently are intended by the Constitutional provisions above referred to. Consequently the franchise, being a contract, the municipality granting it for the State, lacks the power to pass any law, rule or regulation which will be deemed to impair the obligation of that contract or franchise.

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Legal Lighting Rates

The general inspector of the New York Edison Company, found in an investigation of the bills of hundreds of customers, that they were not adding to their current consumption, but reducing it. This came on the heels of the reduction in rates from 15 to 10 cents a kilowatt. An examination of batches of 50 customers in various parts of the city disclosed the fact, that the tendency was toward greater economy. In one section a 25 per cent. decrease was noted; in another section a 12 per cent. decrease; in another section a 19 per cent. decrease, and in certain groups on the west side of the city reductions of from 11 to 22 per cent. in the bills presented *prima facie* evidence that, so far, the influence of reduced rates have not led to the much vaunted theoretical proposition, that less cost means immediately more custom.

A heavy demand from non-users did not set in, at the time these facts were noted, and the legal reduction in rates was published. The proposition of electric lighting in Greater New York to-day stands as follows: There are 4,000,000 people, which at a basis of five to a family constitute 800,000 families, some of which are, and the balance which will use electricity for one or more purposes in their homes. Including private dwellings, and the business establishments now taking current from the electric light mains, it cannot be said that over 50,000 to 60,000 customers in the city are using electricity. The exploitation of the idea, that electricity is and must ultimately become, closely knitted in with the daily schedule in domestic life particularly, is being pursued with energy and success. The success, however, is not of the nature that may be anticipated, from a superficial review of the case.

Electric light and power companies, not only in New York, but in every large city in this country and Europe as well, are in the position of factories selling a certain product. A business and advertising establishment is, therefore, logically a part of the system applicable to the sale of the current. The business or commercial end is, therefore, distinctly different from the technical or scientific end. One produces, but the other only sells. Therefore, when the law steps in and controls prices of the commodity being sold, it does not necessarily follow that the business will take a bound ahead. On the contrary, the opinion may be bruited abroad that swollen surpluses exist and great prosperity supervenes. It may even be considered remarkable that so keen a chase is necessary for new customers. Public opinion, in connection with electric lighting, supplies many curious if not inconsistent standpoints, not the least of which is the supremely judicial satisfaction that all is well, if the legislature aids them in securing what clamor asks for. There is plenty of evidence at hand to show that electric light companies do not succeed to any greater extent than other business enterprises. The first days are generally dark and forbidding and failure frequently stalks across the threshold. The impress of legal action in rate fixing has, in some instances, precipitated calamities of this kind. Much, therefore,

of what is called profit making, will on closer investigation, be found to be absorbed in a further exploitation of the sale of current until success is solidly accomplished in that field.

The investment in the real estate, the machinery, the overhead and underground conductors, and the other elements of the plant is thus seen to be but one side of the picture. The other side is merely a record of expenditures, no physical evidence of which exists except when customers are secured. In this respect, although it cannot be said that intrinsic value does not, to a large extent, exist in the stock issued by the company; it must also be admitted that the intrinsic value of the stock, and the earning power in dividends, represents the degree to which investment in a driving business policy, effective in securing new consumers, has been successful. Though legal rates are an expression of public opinion enforced through the machinery of law, they do not indicate public knowledge, but simply its desires.

Light from Incandescent Vapor

If we stop to inquire into our present methods of producing light, it will be remarkable to realize that they have changed radically and completely. Whatever methods predominated in the past, have made way for new systems of illumination. The burning of a fuel for light has been modified to the extent of burning the fuel only for its heat. We are only interested in two problems, that are the very opposite of each other. One is to get all the heat from given types of fuel during their combustion. The other is to get all the light from the fuel.

A radical change, therefore, has occurred in the point of view. We try to extract all the heat present, by one process, and then utilize it for all the light possible by an entirely distinct, and in some cases unique process. The last method is of great importance because it represents the two links which are essential in the chain of phenomena. For instance, we know that the actual substance giving light, only gives it because they are rendered incandescent by heat. The process summed up, therefore, is that of heat at one end, the substance to be affected, properly situated, and the light as a resultant at the other end.

The method of burning fuel to give light, is rapidly becoming obsolete. The function of the fuel is now regarded as that of the "heat producer" or "energy carrier." The complex mechanical and electrical systems involved, are merely transformers of energy of a chemical or mechanical type into a caloric or optical type. Getting rid, not only of the complexities, but the number of units in use, is one of the great problems of the hour.

The tendency may be widely noted, namely, the production of light from incandescent vapors. Here, the medium is differentiated to a great degree, and the amount of heat required for a given intensity of light is theoretically lower than when the mass affected by heat is solid. To enumerate: electricity produces light by means of incandescence, by means of an arc, and by means of vapors or gases. This is what characterizes electric lighting to-day as most unique; vapors and gases are rendered incandescent and serve as powerful light producers.

To show the true bearing of this idea upon future lighting methods, imagine a carbon rod heated white hot. If the light from the incandescent carbon is measured, it may amount to 2,000 candlepower. But what is becoming of the light which might be given out by the solid incandescent interior of the carbon? We are heating the rod white hot throughout, but only using the light from its *outer* surface. Is there any reason to believe that the same rod, pulverized, and presenting to the eye every one of its carbon molecules, will not give out as much more light as there are more white hot carbon particles in a position to radiate it? By spreading this mass of incandescent carbon particles out over a great volume of space, a greater opportunity for the light waves from the interior mass to radiate, becomes possible. In certain respects, an incandescent vapor or gas, complies with this proposition.

The long flaming arc, produced between carbons impregnated, and supplied with metallic cores is one instance. The use of a mercury vapor rendered incandescent, and really forming a long arc when in use is another instance. And finally, the application of a high tension alternating current, to long tubes of gas, of a particular nature and mixture, is another and equally spectacular instance. The inventiveness betrayed by American investigators is remarkable, if only for the rapid application of their ideas to practice and nothing else. But the efforts now being made to not only invent but to improve; to not only use power but to save it, is one of the dominant features of the art of light making. Efficiency is the watchword, and the best ways of

gaining it are being given broad and comprehensive treatment.

A kilowatt, theoretically, should produce at least 30,000 candle-power, whereas at present, in daily practice, it produces only 300 or 400 candle-power in incandescents, and 2,000 to 3,000 candle-power in arcs. Obtaining something like a legitimate return for the power consumption will mean the goal to which intelligent invention is rapidly hastening.

Commercial Insulation

Five years' testing have been the means of certifying to the qualifications upon which the new insulation Voltax rests its claims. If anything is calculated to impress the electrical engineer with the value of a new insulation, it must be quality first, and cost, the second. The idea of quality involves considerations that apply in general to all types of insulation. Among them may be classed durability, flexibility and immunity from injurious symptoms under the influence of heat and cold. Although it might be said that these are merely expressions of purely physical properties in connection with insulation, it must be understood that the possession of them by a given type of material, or a substance or mixture, is the only means of properly depending upon those electrical properties to which, in the end, the greatest prominence is given.

With respect to a particular form of insulating material like Voltax, two facts of a peculiarly electrical nature must be noted. They are as follows: First, the degree to which its insulation will stand the strain of a high potential; and second, the degree to which it manifests dielectric properties.

For ordinary forms of electric light and power work, the fact that a given type of insulation will ably resist high pressures, and at the same time possess the physical properties spoken of, of durability, flexibility and immunity from heat and cold within reasonable limits, is sufficient to call for its indorsement by the best experts capable of estimating these values.

In central stations and power houses, the demands are greater than a passing glance would seem to indicate as far as insulation is concerned. In this respect, the severity of the tests have not been other than successful. It can stand temperatures which make it particularly serviceable for outside wires. The rating given it, of being unaffected by heat under 250 degrees Fahrenheit, speaks well of its usefulness for all cases where temperature rises in wires result in the carbonizing and destruction of the insulation. Copper wire, covered with Voltax impregnated tape to the extent of four layers of 84 mils thickness, broke down only with a pressure of 27,900 volts. Under other severe and insulation destroying influences, the resistance measured 23,000 ohms. The test in this case being the salt water immersion test lasting 72 hours.

Reviewing the facts as noted in connection with this new insulation, the use of it for important electrical work is, on its face, such that it may be expected to become indispensable in central station work. The ease with which it is poured, when in a viscous state into a wooden trough or troughs, in which conductors have been laid, mounted on insulators, means a saving of many thousands of dollars in the development of a system of underground mains and feeders.

The manufacturers of Voltax, claim in this respect advantages that are possessed by no other practical insulation on the market. The interesting thing about all insulations, is not always revealed in a purely technical review of their properties. They are without question the making or the breaking of a lighting or power enterprise. It might be shown that insulation to-day, is all that may be said to define the limits of power transmission. It is the greatest responsibility of street railway companies to preserve the insulation at its highest throughout the plant. The reason why so many do not, is because they cannot mould their insulation to fit in places where only the ordinary market product can be used.

The vital point about an insulation is not only its actual insulating power, and not only its dielectric properties, but the ease with which it can be made to insulate by being flexible and shapeable. To-day, the demands of practice call for materials and machines that will accomplish results. The technical success means, nine times out of ten, financial success. Where both are found, in a material like Voltax, which cost 20 per cent. less than rubber compounds, the rest is a foregone conclusion.

The illustrated lectures which Mr. A. J. Marshall, illuminating engineer of the Holophane Glass Company, is giving before the central stations and gas companies on the questions of light and illumination, are proving very successful, and it is expected that this work will be the means of greatly assisting the

growing demand for the best kind of lights properly placed for desired effects. Mr. Marshall lectured before the West Penn Electric Company, Connellsville, Pa., on Thursday evening, October 25th, at which an enthusiastic audience displayed great interest.

The Holophane Glass Company wishes to state in this connection that while this lecturing is planned out for some time ahead, they will, nevertheless, be pleased to consider application for this kind of work and deliver lectures in the order that requests are received.

MONTHLY REVIEW OF THE TECHNICAL PRESS

The Street Lighting Question.

Our boastful enemy is again on the war-path. A monthly municipal contemporary, posing as an impartial publication, prints an article on "Gas *v.* Electricity," by a very pronounced gas advocate.

The subject matter is street lighting, and the pith is, of course, the threadbare "triumph" in the city. He complains that in London the judgment of the authorities is in some cases influenced by the fact that the electricity supply is in their hands. No doubt; and in many provincial towns where the gas undertaking is in the hands of the local authority there is a similar bias in favor of gas. It is an unfortunate fact that the good of the community is often sacrificed in order to show a false profit on municipal enterprise. When, however, the writer makes such obviously untenable statements as that the Islington arc lamps illuminate the streets no better than a number of paltry gas lamps, we can no longer join issue with him. Some considerable pains are taken to prove that the ideal street lighting is to be obtained by placing a number of small units fairly close together, and by a process of reasoning based on the effective illumination varying as the square of the distance, the writer appears to arrive at the conclusion that 350-c.p. high-pressure gas lamps, 12 ft. from the pavement and 24 yards apart, exactly meet the case.

But if small units, and many of them, are to be the order of the day, why use high-pressure lamps at all? Why not ordinary incandescent mantles, or batswing burners, or, better still, a series of 1-c p. gas jets? Calculating on the basis of 350 c.p., 12 ft. high and 24 yards apart, we should arrive at a picturesque series of 1-c.p. lamps 8 in. high and 3 ft. 11 in. apart, *which is absurd!*

Clearly the whole matter hinges on the question of which is the more efficient in the long run: to use high candle-power lamps (which with gas, as well as electricity, are considerably more efficient than low candle-power ones) at a fair distance apart, and put up with the inevitable loss due to the necessity for hoisting them up in the air in order that their rays may be more or less uniformly distributed; or to use low candle-power lamps of lower efficiency, and save the loss referred to by being able to put them on shorter posts, owing to their being closer together. Practice proves that with both illuminants the higher candle-power lamps are so efficient as to more than

make up for the loss due to their being placed high up. Hence the use of the high-pressure gas lamp and also of the arc lamp for public lighting.

A motor lamp lights the roadway perfectly, but leaves the upper strata pitchy dark by contrast. A broad street with high buildings requires large units at a considerable height. Narrow streets with squalid buildings are better served with comparatively short posts, and consequently much lower candle-power lamps suffice. Now the particular candle-power, height and spacing is clearly dependent on the nature of the thoroughfare, and no hard and fast rule can be made which will justify the use of lamps of 350 or any other definite-candle-power.

The reason why a broad street is better lit by arc lamps than by any other known source of light—and no amount of literary effort on the part of our gas brethren can discount this statement, which is obvious to any impartial observer—is the fact that the greater part of the light is thrown downwards at an angle from a considerable height, and is, therefore, more diffused than if it came from a large number of small sources at a height nearer the level of the eyes. In other words, the former is a nearer approximation than the latter to daylight, which is a perfectly diffused light coming from one large source. A small number of high candle-power lamps are cheaper to run than a large number of low candle-power ones, and no one knows that better than the advocates of gas; if they could produce a light as good as an arc lamp, the gas people would soon change their tactics. Indeed, it is not surprising that the flame arc lamp "is beginning to offend the eye and irritate the nerves" of the writer in question, whose references to the Gas Light and Coke Co. suggest an intimate connection with that enterprising, if misinformed concern.

The writer goes into the relative costs of high pressure gas lamps and arc lamps, and in doing so he does what has once been said of a well-known lady novelist; he sets up an Aunt Sally of his own manufacture, and then amuses himself by shying at it. He lays down the law that 90 gas lamps, which he estimates at 350 c.p. apiece, will light a mile of street at least as well as 60 arc lamps, each of which he is generous enough to credit with 700 c.p. He goes through a series of carefully constructed figures, which terminate in the conclusion that the arcs are nearly twice as costly as the gas lamps. He does not mention whether his mantles are all brand new in order to give him 350 c.p. His comparison with flame arcs is not quite so successful. These, he admits, give 1,200 c.p., so he only takes 40 of them, with 8 amperes instead of 10, as in the case of the ordinary arcs. At the end of the juggling, gas is made to cost £660, and electricity £880. It is not difficult to see that with the bias on the other side, these figures would be reversed. In passing, it may be mentioned that at a later stage in the article the writer points out the unreliability of comparative tests of candle-power made in the streets. What a pity he based his figures on candle-power! He half admits that these consideration are theoretical, so he next proceeds to what he calls the practical side of the question. He mentions nine metropolitan districts out of twelve which do not possess an electric supply undertaking, where there is no electric street lighting. He next cites Liverpool and Bradford, the former possessing some hundreds of arc lamps, and the latter admittedly one of the worst lit towns in the kingdom, also of the city of London—but we know all about that—and Westminster, as cases of gas being preferred to electricity. Here is a little list to set against his. It is a list of towns where both the gas and electric light undertakings are owned by private companies, and where gas has been replaced by electricity for public lighting in all or nearly all the streets:—High Barnet, Bournemouth, Brechin, Callow, Chelmsford, Dartmouth, Fleetwood, Frome, Godalming, Hawick, Hythe, Lymington Melton, Mowbray, Montrose, Newton Abbot, Prescot, Redruth, Sandown, Ventnor, Wellingborough, Windsor, and High Wycombe. Also Blaenau Festiniog and Llan Festiniog, *where the gas is owned by the local authority*. Let our gas friends put that in their pipe and smoke it. Then let them read the following list of some of the towns where both illuminants are supplied by the local authority, and where gas has either been entirely supplanted by our illuminant, or arc lamps installed in all the more important thoroughfares:—Aberdeen, Accrington, Barrow-in-Furness, Batley, Birkenhead, Blackburn, Blackpool, Darwen, Edinburgh, Glasgow, Morecambe, Leeds, Nottingham, Paisley, Partick, Perth, Salford, Southport, Wallasey, and West Brunswick.

We admire the enterprise of our rivals in scattering statements broadcast which are intended to mislead the public into believing that electricity is no longer the best street illuminant. But their arguments will not wash. You may talk about candle-

powers till all is blue, but if you take a man along two streets, one lit by the best arc lamps, and the other by the best gas lamps, there is no question but that he will tell you that the latter is not to be compared to the former. Money may be saved by lowering the standard of street illumination, but to do so it is not necessary to use gas. There are many varieties of electric lamps on the market which can compete successfully in price with the corresponding gas lamp.

We cannot close these remarks without saying a few words about the interview with Mr. Morton, the chairman of the Streets Committee of the City of London. Here are one or two of Mr. Morton's statements as examples of his *lack* of bias:—"Apart from any question of cost, I think we cannot obtain as efficient a light from any description of electric arc lamp as from incandescent gas lamps." Referring to the city arc lamps, he says: "We are getting quite four times the amount of light for the same money or less." Referring to the burning of arcs and gas lamps side by side in Monument street, he says, "Practically all the light was coming from the gas lamps." Comment is superfluous.

In regard to side street lighting, the writer admits the rivalry of the Nernst lamp with the incandescent gas lamp. He compares a 90-c.p. gas mantle with a ½-ampere Nernst, and calculates the energy consumption of the latter at £3 7s. 6d. per annum for 4,000 hours' burning, with energy at 1½d. per unit. In the first place, his figure for the Nernst lamp is inaccurate, and in the second place, we do not remember having seen a Welsbach burner of 90 c.p. This article, *immediately after erection,* is usually credited with from 50 to 60 c.p., and its consumption is given as about 4 cu. ft. per hour. Hence we may assure that the hypothetical 90-c.p. mantle takes at least 6 cu. ft. per hour. With these corrections the figures will tell quite another story. As a matter of fact, the average price charged for gas lighting throughout the country on a 4,000-hour basis is about £3 12s. 6d., and there are many places where Nernst lighting is done for less than £3 per lamp per annum.—*London Electrical Review.*

CURRENT IDEAS

For Furnishing More Light, Heat and Power from Central Stations

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Organization and Conduct of a New Business Department Suitable for Central Stations in Cities of 50,000 Population and Under

By James L. Wiltse

A commercial or business department is a necessity with a central station, or in other words, it is the life blood of the central station. Its value is two fold; first, that it brings the company into close relations with the public, and second, that it increases the business of the company. The importance of this department is recognized by many central station managers, and with great resultant benefits to their companies.

This department is to be organized in a company which has had no separate department to take care of its commercial business. It will have charge of all present and prospective customers of the company, excepting the collection of bills. The principal object is to increase and hold the business of the company.

The first thing in the organization of this department, is the selection of a competent head for the department. This is a question of utmost importance to a central station manager, and great care should be exercised in selecting a man who realizes the importance and responsibility of the position. He should be a man who has had central station experience, and one who realizes the necessity of tactful treatment with those with whom he comes in contact.

The principal duties of the head of the department will be to take entire charge of such depart-

ment and to look after the company's interests, in securing and holding business. He will be responsible for the acts of his solicitors and it should be his duty to see that all possible efforts are put forth by his men in the direction of following up and securing new business. He also settles questions of rates, guarantees, line extensions, and all the minor matters connected with the wishes and requirements of the public. He should take care of all complaints from customers, and should also be capable of taking complete charge of advertising.

Having secured our contract agent, the next important consideration is the selection of solicitors for outside representatives. As to these, two will be sufficient to start with. These men should have some experience with central station work and have a knowledge of light and power engineering. They should be paid a straight salary. This is more advisable than paying them on a commission basis, as better men can be secured by this method of compensation. Each solicitor should be given a certain territory, in which his duty would be to take care of the present customers, and to secure new business. These men are to report at the office once a day, make a report of each call and the results, and issue all necessary orders to the proper departments to make connections, etc., and for care of business secured by them.

The contract agent should have an assistant to take charge of the office, see that the solicitors' work and reports are kept up, and take general charge of the details of the office. This man should be capable of taking care of all customers coming into the office.

We have now the organization ready to start the sale of our product. This brings up the question: "How shall we push the sale of electric current?" or, "What method will be adopt to secure new business?" Here is a large field, and if the company will work all of its branches within reasonable limits, the growth of the central station business will surely increase greatly.

There are two channels through which we should go to get business. One is through advertising, the other through the outside representatives or solicitors. Advertising is essential because it informs the this purpose, simply means the educating of the public to the adaptability of electricity to the everyday needs of the office, the factory, and the home. Many are diffident regarding its use on account of lack of knowledge. Therefore, an educational campaign is advisable to train and familiarize them with the subject. Advertise freely in the local newspapers, as the majority of the people in the small cities read the local papers.

Another good form is in mailing literature in the form of pamphlets or circulars, relating to the many advantages and uses of electricity. Enclose with each a return post card, so that it can be signed and returned for the purpose of having a representative call. This not only advertises your product, but gives them a "lead." This system of advertising should be checked up and where necessary, followed up with more advertising as well as personal canvass.

As a means of keeping present customers awake to the many uses of electricity, a small paster should be attached to their bills, giving a brief description of the articles you wish to advertise or place before them; such as fans, flat irons, heating and cooking utensils, etc.

Another good scheme is to erect an attractive electric sign outside of the office. This shows that the company believes in efficiency of electric signs, as well as helping to promote the sign business.

Right here, I might say that an attractive office, fitted up with fixtures, shades, etc., giving ideas regarding illumination, and also an exhibition of electric cooking, heating, and other electrical devices, will prove a very good advertisement.

The next and the best method of getting business is through the solicitors. We have two men to start out and as they have been given such a good lead through the advertising, it is so much easier for them to get business, either through canvassing and answering inquiries, or follow up work on advertising.

With all central stations the peak load is generally in the early part of the evening and it is, therefore, an important item for the company to secure business which will even up the load. To do this it is necessary for the business department to work on installations such as power and heating.

In order to develop the power business, the solicitor should be familiar with the other forms of power, and state their comparative disadvantage. They should also be able to lay out power installations in the most economical way, and see that customers follow suggestions and get the desired results.

Another good way to increase business if there are many small users of power who cannot afford to

lay out the money for a new electric equipment, is to advance the cost of the motor or motors to him which can be repaid in monthly instalments. This means revenue for the central station, and should, therefore, be given special attention. The solicitors should keep close watch on all gas engines and when they break down or give trouble, get on the ground and talk electric power.

In addition to the power business, there is a newer field for the use of electric current, which will also help to even up the load on the company's system. This is electric heating. Of the revenue producing heating devices the electric flat iron has already begun to show results to central station companies, which have had the foresight to actively push its use. There are also heating and cooking devices, which, while not great revenue producers, are good advertisers, and help to swell the gross receipts. The best method of increasing this business is to deliver these heating and cooking devices in 30 days' trial, and if same are satisfactory, they should be sold at practically cost. With the electric flat iron, it is in most cases advisable to loan the iron to the customer, and the increased current consumption will soon repay the company.

Besides the many advantages of electricity over the other forms of illumination, there is one especially important point to bear in mind in securing this business, and that is, the proper layout of the lights. It is, therefore, needful that the solicitors have a knowledge of illuminating engineering, as in some cases, it is only by this method that customers may be secured and satisfied.

The electric sign business should be given attention and the company should furnish and install signs on the premises of customers free of charge. This method has met with much success in many central stations. The usual form is that customers are required to sign a contract with a minimum charge per month. The company could furnish clock switches for signs where customers desire the sign to burn after the closing hours. It is to their interests to do this, as it not only means increased current consumption, but induces other merchants on the street to make their places attractive by night as well.

The idea is for the central station to work up the matter of proper illumination and get the merchants in the city into a more liberal use of light, not only during open hours, but after stores are closed for the evening.

In a new department of this kind, we must initiate an accurate system of keeing records and following up new business. To do this the solicitors should be provided with a small card index file, in which they should keep a record of all prospective business, and see that it is followed up properly. They shall note the date and result of every call. In addition to this they should make a separate report to the office of every call. Agents should be furnished with blank forms for this purpose. These should be of three kinds, each a different color; one form to be used when a customer's application is secured, another form for prospective business, where customer will consider the use of current, and the other form for holding present business or other miscellaneous reports. After checking these reports in the office, they should be filed, excepting reports, where people are considering the use of current, which should be filed temporarily and followed up until contract is closed.

The following is a form which can be used for this purpose.

All forms to be printed the same, but each form to have a different color.

Solicitor's Daily Report.

Location ....Present Form Power.......

Name .... Estimated H. P. required...

Business ....Used for ....

Present Lighting ....Will customer consider.....

Probable Installation ....Remarks ....

Wired ....

Date...........Checked by............Solicitor..........

In this way the solicitor's work can be checked up, and every month a report can be made up of the number of calls, and the amount and kind of business secured by him.

A card of all customers should be kept as follows:

Address ....Business ....

Name ....

Application dated.........Rate.........Solicitor.........

Order Issued.	Installation.	Connect or Disconnect.	Completed.	Remarks.

This card can be used to keep a complete record of the customer's installation, etc., and any other

records necessary can be entered on the other side of the card.

All records of this office should be filed according to location.

Two card catalogs should be kept, one for connected, and the other for disconnected customers.

The solicitors should make out the working orders for the business secured by them. After being checked and recorded in the office, the order should then be approved by the credit department. After it has been properly approved, it is forwarded to the installation department to do the work.

The office is to keep a record of all business secured, and this can be done by keeping a report showing each day's business, as follows:

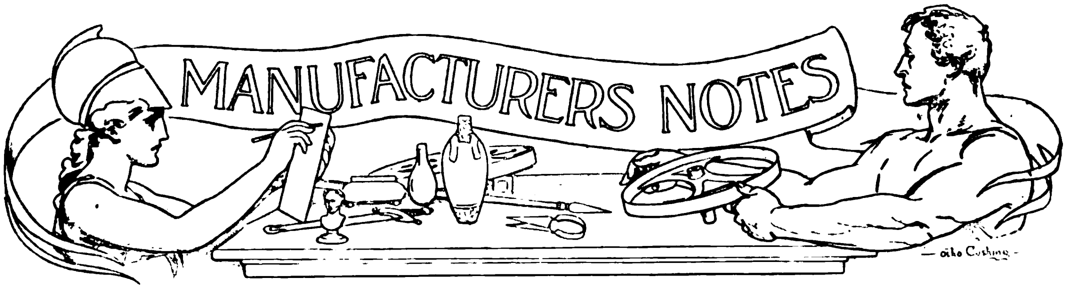
REPORT OF BUSINESS SECURED, 190..

Name.	Address.	Incs.	Arcs.	Power.	Misc.	Remarks.	Solicitor.

These sheets can be totaled up each day, and at the end of the month a report can be readily made showing the business secured during the month.

To operate a department such as outlined here, the cost will be approximately as follows:

Salary of contract agent per year......	$1,800
Two solicitors, each $18 per week, per year	1,872
One clerk, $12.00 per week, per year	624
For advertising, per year.............	2,000
Total	$6,296



A Commercial Type of Automatic Time Switch

There is a growing demand, particularly in electric lighting, for an automatic time switch for opening and closing electrical circuits. The time switch shown in the accompanying illustration was designed by the General Electric Company to meet the definite requirements of this class of service being adapted for both alternating and direct current.

This automatic time switch consists of an electrical circuit breaker operated and controlled by a single clock movement of heavy and rigid design. The parts are mounted compactly in an iron case with two distinct compartments. The upper portion contains the clock protected against dust and moisture, and the lower part holds the circuit breaker mounted on a porcelain terminal board. Clock and circuit breaker being operated by the same main-spring require a minimum number of parts.

The clock movement is of simple and rugged construction. The lever escapement will withstand hard usage and vibration. Extra long bushings and pivots are provided and the gear teeth and pinions are very heavy.

The circuit breaker has a number of interesting constructive features. The brushes are built up of spring leaf copper and the outside leaf is provided with an arc burning tip, so that the main contact surface does not become roughened, but presents always a smooth rubbing surface.

Clock and circuit breaker are connected by a simple release mechanism. The clock movement rotates a dial once every twenty-four hours. The dial is graduated in quarter hours, and for convenience in distinguishing night and day, one half of the

dial is blackened. At the edge of the dial are two cams which revolve with a dial and, acting through levers, control the operation of the circuit breaker.

In addition to this compact and durable operating mechanism, a small lamp within the clock case increases the reliability of the switch when it is exposed to low temperatures. If the time switch

AUTOMATIC TIME SWITCH (OPEN).

is installed in an obscure position, the light from the lamp is also of service in examining the apparatus.

This time switch is independent of failure of current, being entirely mechanical in action. The principal mechanism is visible when the door is open and when the door is closed the apparatus is made dust and water tight by a rubber gasket and sealing clamp, which draws the door tightly closed as the handle is turned. The door can then be locked and sealed if necessary. The General Electric Company rates this time switch at 25 amperes and 250 volts.

Benjamin Electric Manufacturing Company, of Chicago, New York and San Francisco, manufacturers of the famous Benjamin wireless clusters and lighting specialties, has just issued a new 105-page catalog, illustrating and describing their various forms of wireless clusters, arc bursts, outlet box receptacles and the necessary fittings for same. The catalog is most carefully prepared with full directions as to how to order these supplies, and will be sent to any reader of THE CENTRAL STATION upon request.

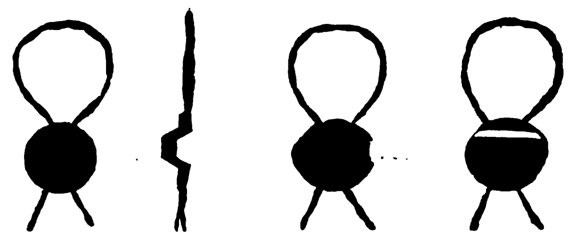
The Pittsburg Gage and Supply Co., Pittsburg, Pa., are installing a large number of White Star Continuous Oiling Systems. The simplification of handling oil, the feeding of a regular supply to the bearings, the elimination of wastage over hand oiling and the mechanical purification of the used oil thereby cutting the oil bills down and reducing the cost of attention to a minimum, with the certainty of copious lubrication has led such representative concerns as the following to specify and install the White Star system:

Brier Hill I. and Coal Co., Youngstown, O.
Embree Iron Co., Embreeville, Tenn.
Bullock Elec. Mfg. Co., East Norwood, O.
Sargent & Co., New Haven, Conn.
National Car Wheel Co., West Homestead, Pa.
Copper Queen Cons. Mfg. Co., Douglas, Ariz.
Brush Elec. Lt. and P. Co., Galveston, Tex.
Illinois Steel Co., Joliet, Ill.
Consol. Gas, E. L. and P. Co., Baltimore, Md.

Their catalog on oiling system is to be had by anyone interested.

H. C. K. Co., of 45 Broadway, New York City, is meeting with big success with its new lead seal presses for sealing gas and electric meters. This press, which is here illustrated, raises a letter or figure on the back of the seal, which identifies the

press, the user of which is responsible. Initials of the lighting company can, at the same time, be raised on the front side of the lead seal, as shown in the accompanying cut of the seals. The above com-



pany is receiving many orders for this useful little tool, the following being among the recent ones received from central stations:

		Presses.
Rumford Falls Light and Water Co., Rumford Falls, Me.		3
Cleveland Electric Illuminating Co., Cleveland. O.		35
Youngstown Consolidated Gas and Electric Co., Youngstown, O.		5
Milwaukee Electric Railway and Light Co., Milwaukee, Wis.		12
Butte Electric and Power Co., Butte, Mont.		6
Los Angeles Gas and Electric Co., Los Angeles, Cal.		18
Edison Electric Co., Los Angeles, Cal.		36

Allis-Chalmers Engines and Generators in a Model Power Plant

The city of Scranton, Pa., has had another electric lighting and power plant added to its list of utilities, in the shape of the Lackawanna Light Company, a concern capitalized for $400,000, which has entered into competition for the business of the city of Scranton against a number of competing companies, and whose complete plant equipment from the breaking of ground to actual operation was built between March 23rd and September 1st of this year.

This modern central station is equipped for a capacity of 1,500 kw., with several miles of iron pole line, 30 miles of underground conduit construction, 12 miles of underground cable laid, in addition to a whole electric light system, including a sub-station.

The power house, situated at the corner of Sanderson avenue and Glen street, is an unpretentious looking steel and brick structure, fireproof, divided into boiler and dynamo rooms by a brick wall placed lengthwise of the building.

The power house is placed in convenient proximity to the fuel supply. Coal, which is very cheap in Scranton, is obtained from the culm piles within the city limits, from which the finer sizes of anthracite can be obtained.

Four Stirling water tube boilers in batteries of two give the plant a total horse-power steam capacity of 1,600. The grates used are designed specially for the use of the culm product fuel, with which a forced draft is employed.

The two main generating units are identical in design, each consisting of an Allis-Chalmers cross compound Reynolds Corliss engine, built at the Scranton works of the Allis-Chalmers Company, direct coupled to an Allis-Chalmers alternator. The cylinder dimensions for the engines are 23 and 36" x 42", designed for a continuous load of 1,000 h.p. The alternators deliver 60 cycles, 3-phase current at 4,100 volts. Each alternator is separately excited from belt-driven exciter delivering 160 amperes at a potential of 125 volts. A 75-h.p. high-speed engine direct conected to a 40-kw., direct-current generator furnishes the exciter current.

The switchboard is composed of six black slate panels, two generators, one exciter, one regulating and two feeder. The three-phase, four-wire system of distribution is employed for convenience and economy in the secondary distribution systems.

Over $40,000 has been expended in the underground system through the heart of the business section, sufficient to carry twice the existing lamp and motor load in the territory covered. A substation has been erected in the rear of the company's office in which there are two motor generator sets for transforming alternating to direct current.

The Boston Edison Company have placed another order with the Stanley-G. I. Electric Manufacturing Co., for 500 Wright Demand Indicators, making a total of, approximately, 20,000 of these instruments used in the territory served by the Boston Edison Company.

The Chicago Edison Company have, approximately, 30,000 Wright Demand Indicators in use in connection with the demand system of charging for current, in vogue in that city.

The Wright Demand Indicator determines the actual maximum current which passed through it since it was last set. Connected in series with a watt-hour meter, it offers the logical and scientifically correct means of charging for electricity. It is also extremely useful in checking up the load on transformers and thereby suiting them to the requirements of their respective circuits.

Valuable data regarding the progress of the demand systems of charging for electricity and interesting discussions on the subject may be had by addressing the Stanley-G. I. Electric Manufacturing Co., Pittsfield, Mass.

The De La Vergne Machine Company, foot of East 138th street, New York City, has just issued a folder describing the Klein water cooling tower built by them. These towers will cool the water

to from 5 to 15 degrees below the temperature of the atmosphere.

The Cleveland Gas and Electric Fixture Company, of Cleveland, Ohio, is now placing upon the market, especially to be carried in the stock rooms of electric lighting stations, a most complete line of gas, electric and combination fixtures, known as their "C" box line fixtures. The novel feature of this new line of fixtures is that every part of each one of the fixtures is carefully wrapped and placed in a small pasteboard box, on the end of which the fixture which the box contains is illustrated, and a complete list of the parts contained in the box is printed.

This new system of packing fixtures is entirely nal with the above company, which has applied for patent on same, and enables electric lighting stations to carry a very large and varied assortment of fixtures, for the use of their customers, in their stock rooms.

Every part of these fixtures being separately and carefully wrapped and enclosed in this special form of box, insures their being in perfect condition for use, however long they may be kept in stock. The accompanying illustration shows very clearly this novel and most convenient method of packing, shipping and storing.

A FEW BOXES, INCLUDING ONE UNPACKED AND ITS CONTENTS.
These boxes are 14½ inches long, 4½ inches wide and 4½ inches deep. They are made of strong cardboard, divided into compartments for the various parts of the fixture, insuring them against damage or loss of parts in stock room. Patents applied for on these packages.

The Westinghouse Machine Company have on order for the Philadelphia Rapid Transit Company's Wyoming Avenue Power Station, three turbine generator units, each of 6,000-kw. capacity; these with the one now in course of erection, will make

four units of 6,000-kw. capacity each in this station. Six 1,500-kw. Westinghouse turbine generator units have been operating in this station for the past year, and it is their extremely satisfactory performance that led to the placing of the order for the four 6,000-kw. units, making this one of the largest power stations in the country.

W. L. Hedenberg Publishing Co., 136 Liberty street, report that there would certainly seem to be a demand for a non-mathematical work on alternating currents, judging from the recent sales of the book entitled "Practical Alternating Currents and Power Transmission," by Newton Harrison, which only came from the press a few weeks ago.

The show rooms of McKenney & Waterbury Co., 181 Franklin corner Congress streets, Boston, Mass., are worthy of a visit to all interested in the art of lighting fixtures for the same. There are over one thousand lights, showing effects to meet all decorations and a display of electric and gas table lamps, with art shades, which make most acceptable wedding and anniversary gifts.

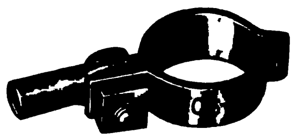
The Norman W. Henley Publishing Company, of 132 Nassau street, New York City, publishers of scientific books, now has ready for distribution a very useful treatise entitled, "Practical Lettering," for draughtsmen and engineers, which describes and illustrates a rapid and accurate method of becoming a good letterer with little practice. Until the appearance of this work, no systematic method of spacing has been published. This work, which is in pamphlet form with paper cover, will be mailed to any address upon receipt of 60c.

Allis-Chalmers Company, of Milwaukee, Wis., report the following recent sales made by their steam engine department: Mobile Light & R. R. Co., Mobile, Ala., two engines direct connected to two 550-kw., D. C. Allis-Chalmers generators. One 14 by 24 Reynolds Reliance Corliss engine to the Weyburn Machine and Electric Light Company, Weyburn, Canada. Ventura Power Company, Ventura, Cal., one 15 by 32 by 36 Reynolds heavy duty, tandem compound Corliss engine, connected to 300-kw. Allis-Chalmers generator. This company has also recently furnished a large quantity of apparatus including engines, generators and other electrical apparatus for the Indianapolis, Crawfordsville & Western Traction Company, at Crawfordsville, Ind.

Central station managers have for a long time felt the need of a reliable method of removing the dangers connected with secondary distribution systems.

With this end in view the Chase-Shawmut Company, of Newburyport, Mass., has put on the market the Shawmut All Copper Ground Connection Clamp which they offer as a means of overcoming these dangers so prevalent with secondary systems.

This clamp is made of two pieces of copper held together with an iron bolt, and is made to fit any size of pipe from one-half to three inches. A terminal lug is provided large enough to take a No. 4 wire.



GROUND CONNECTION CLAMP.

For simplicity, strength and maximum contact area, the clamp is one of the best and cheapest on the market.

With the secondary circuits grounded by these clamps, the best possible protection against fire and personal injury will be provided.

The Chase-Shawmut Company is now preparing a little pamphlet on the All Copper Ground Connection Clamp which they will distribute among the trade.

Coöperative Electrical Development Association.

Mr. Arthur Williams, President of the National Electric Light Association, arranged a few weeks ago, a committee of five central station managers, to coöperate in the developing and execution of the plans of the Coöperative Electrical Development Association.

This committee, which consisted of three members last year, has been enlarged this year to a committee of five, consisting of the following very representative gentlemen:

Mr. W. W. Freeman, Brooklyn Edison Company, Chairman; Mr. John W. Gilchrist, Chicago Edison Co.; Mr. R. S. Hale, Boston Edison Co.; Mr. J. E. Montague, Buffalo and Niagara Falls Electric Light and Power Co.; Mr. F. M. Tait, Dayton Lighting Company.

Mr. Paul Spencer, the previous chairman, rendered excellent service in the development of the

plans last year, but special attention required on another committee, necessitated his withdrawal.

Mr. Freeman called a meeting of the above committee in Brooklyn on October 30th, and the entire day was given over to a careful and detailed consideration of the proposed Constitution and By-Laws, as well as the detailed commercial plans for 1907, submitted by Mr. J. Robert Crouse. The committee was honored for a good portion of the day by the presence of President Williams.

This conference, which will be followed rapidly by similar conferences with the coöperating committees of the manufacturers, jobbers, contractors and representatives of the technical press and advertising agencies, is all preliminary to a meeting of the joint committee of all branches of the trade, to be held in New York within a few weeks, at which it is expected to formally complete and finally agree upon a scheme of organization and the commercial plans for work in 1907.

After a very busy day, Chairman Freeman and his associates, Mr. W. F. Wells, Joseph F. Becker, Jr., P. R. Atkinson, M. S. Seelman, gave a dinner for the confréres at Delmonico's, followed by a theater party. The day's activities concluded very pleasantly with a luncheon and smoker given by President Williams.

It was the unanimous expression that the day had been crowded full of "coöperation," so both business and social, as was possible, and this meeting doubtless marks a long step in the progress of this coöperative campaign, which is now going to be recognized by all branches of the trade as having very great commercial possibilities.

The American Engine Company, of Bound Brook, N. J., has recently booked repeat orders, as follows: Three duplex compound engines to the Eli Dupont Co., to be used in its new plant in Toluca, Colo., making the eighth order from this well-known company for American Ball duplex compound engines. One 200-kw. generating set, consisting of American Ball generator direct-connected to a duplex compound engine for the American Vulcanized Fiber Company, of Wilmington, Del., this being the third order for duplex compound engines for this company. Three complete generating sets, two of 75-kw. and one of 150-kw. capacity, driven by duplex compound engines for the Cambridge Gas Light Company, of Cambridge, Mass. The following electrical equipment has been shipped to the W. D. Boyce Company, paper mills at Marseilles, Ill.; two 200-kw., direct-current, 500-volt generators, to be driven by water wheels, and two 125-hp. and one 300-hp. motors.

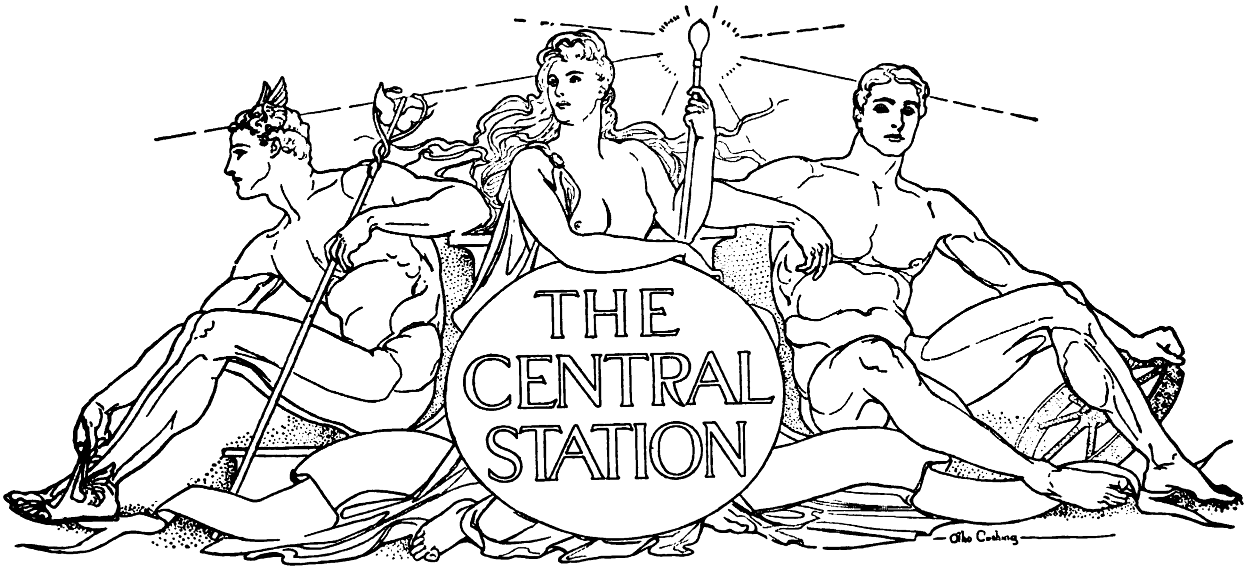
Mr. W. W. Merrill, secretary of the Chicago Fuse Wire & Manufacturing Company, advises that it has made arrangements with Mr. G. A. Knoche, who was connected with the Wesco Supply Co., St. Louis, for many years as purchasing agent and in other positions of responsibility, to represent the company in the Southwestern States, with headquarters at 539 Frisco Building, St. Louis. He will push the sale of its well-known line of goods, consisting of Union outlet and switch boxes, fuse wire and links and Union enclosed fuses and blocks. The trade will be interested in learning that the Underwriters' National Electric Association has recently approved its line of fuses, National Electrical Code. The company is in a position to ship goods promptly from its Chicago factory.

Personal

Mr. M. R. Porter, formerly sales manager and a director of the Belknap Hardware and Manufacturing Company, of Louisville, Ky., has just been appointed manager of sales of the Pittsburg Gage and Supply Company, manufacturers of the White Star Continuous Oiling System, which is now being universally adopted by electric lighting and power stations all over this country, on account of the wonderful saving of lubricating oils by the use of this system.

Mr. Harry B. Kirkland, so long and well known in the electrical fraternity as representing the American Circular Loom Company, of Chelsea, Mass., has resigned his position with the above company, to accept that of assistant general sales manager of the National Metal Molding Company of Pittsburg, Pa.

Mr. Colin P. Campbell, attorney at law, of Grand Rapids, Mich., who has, for the past two years, been contributing the interesting and valuable Legal Decisions Affecting Electric Lighting and Power Stations in this paper, has just been elected to the Legislature of his State, and, although his duties will be considerably increased, The Central Station will continue to receive and publish his articles which have, in so many cases, proved of inestimable value to the readers of The Central Station.



DEVOTED EXCLUSIVELY TO THE INTERESTS OF ELECTRIC LIGHTING AND POWER STATIONS.

VOL. 6, No. 7 NEW YORK, JANUARY, 1907 ISSUED MONTHLY

Central Station Light, Heat and Power Principles

By Newton Harrison.

Capacity and Inductance in Power Lines. Great power plants are connected with the points of distribution by transmission lines. These lines are affected in two respects: first, the electrostatic effect of one upon the other and each upon the earth; second, the electromagnetic effect of self and mutual induction. The two effects may be entitled the inductance and the capacity of the line.

Non-Inductive Circuits. The conditions which make a circuit inductive or non-inductive may be regarded as those which individually and collectively add more or less of a varying magnetic field to the circuit. For instance, a core of iron, around which a coil of wire carrying an alternating current is wound, is an extreme case of inductance. The removal of the iron core reduces the degree of inductance, and the straightening of the wire from its coiled form still further reduces it; when two straight wires are employed for the purpose of transmitting electrical energy in the form of an alternating current, they have the least effect inductively upon each other when closest together. In other words, if one wire leading out and the other leading back to the power house are installed a short distance away from each other, the effects of self-induction are less than when they are widely separated. But a wide separation between high-tension wires is relatively necessary, as insulation could not otherwise be secured, particularly during conditions of great dampness or severe rain.

Distance Between Conductors. The distance between copper conductors will influence the degree of inductance to an extent indicated by the following figures: For a No. 0 B & S gauge pair of wires, run parallel and at a distance of 12, 18, 24 and 48 inches apart, the inductance in each case will be, respectively, .00254, .00276, .00293 and .00331 henrys. A line is necessarily possessed of a certain amount of induction which, in the estimate of its true carrying capacity, calls for consideration. It is quite evident that the increasing value of high potentials necessitates the use of greater distances between power lines than would be otherwise necessary. Tests have been made for the purpose of determining the pressure and distance over which spontaneous sparking would result. The results

have been tabulated in a case where a wave form of current was employed with the spark leaping between needle points. A chart with a curve (Fig. 1) showing the relationship between the distance and pressure with corresponding data is given. The diagrammatic and tabular form in which these facts are given will provide some idea of the conditions resulting from the use of high pressures when the questions of inductance and insulation arise.

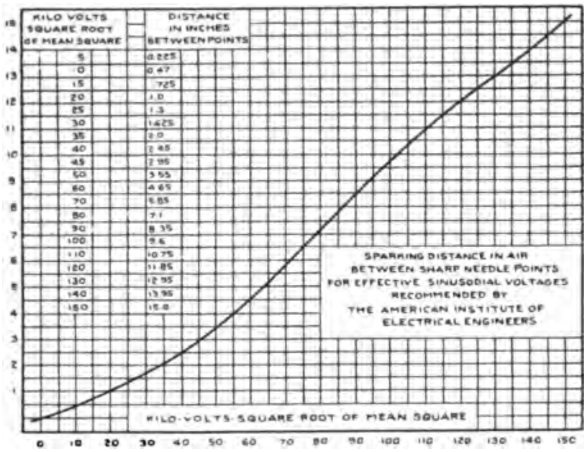


FIG. 1.

SPARKING DISTANCE IN AIR FOR GIVEN PRESSURES

Volts	Inches	Volts	Inches
5,000	0.225	60,000	4.65
10,000	0.49	70,000	5.85
15,000	0.725	80,000	7.10
20,000	1.000	90,000	8.35
25,000	1.300	100,000	9.60
30,000	1.625	110,000	10.75
35,000	2.000	120,000	11.85
40,000	2.45	130,000	12.95
45,000	2.95	140,000	13.95
50,000	3.55	150,000	15.00

According to these figures, the tendency to reach and pass 100,000 volts for power transmission will mean a distance between conductors exceeding 10 inches. In fact, for the sake of safety, it would have to be considerably greater. High voltages like these are employed in insulation testing, where what is called a breakdown test is made to discover the pressure necessary to puncture the insulating material.

Calculating the Inductance Between Wires. Various tests may be made to ascertain the amount of inductance between two parallel wires of copper or aluminum by employing a galvanometer and measuring the results obtained. On the other hand, fairly accurate calculations can be made by selecting and using a reliable and simple formula for the same purpose. A formula of this character is given in which

A = distance between the wires in inches
d = diameter of the wires in inches
L = the inductance in henrys,

then the total inductance per mile of circuit is found by means of logarithms in the following formula:

$$L = .000558 \left[2.303 \log. \left(\frac{2\,A}{d} \right) + .25 \right]$$

In this formula the logarithm of $\frac{2\,A}{d}$ is a very simple matter to obtain by the average student of arithmetic. A book of logarithms will contain directions for getting results by their use, a matter that can hardly be treated in this article. A table can be built up, based upon this formula, in which the inductance is calculated for various distances between wires of different diameters. A table of this character, which will prove serviceable in form-

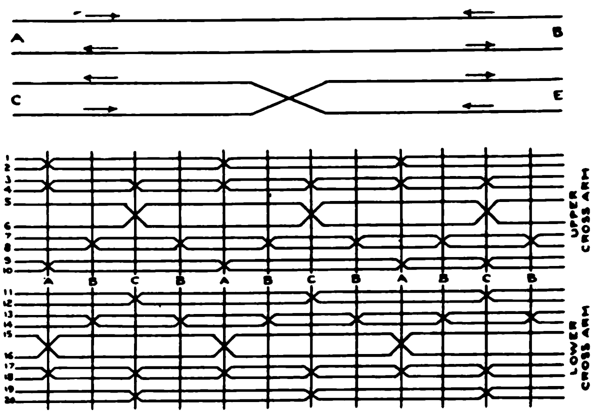


FIG. 2.

ing preliminary estimates of results in this respect in lines about to be constructed, is hereby given:

INDUCTANCE PER MILE OF CIRCUIT

Size B. & S. gauge.	Diameter of wire in inches.	Distance between wires in inches.	Henrys of inductance.
0000	.46	12	.00234
		18	
		24	
		48	
000	.41	12	.00241

		18	
		24	
		48	
00	.365	12	.00248
		18	
		24	
		48	
0	.325	12	.00254
		18	
		24	
		48	
1	.289	12	.00260
		18	
		24	
		48	
2	.258	12	.00267
		18	
		24	
		48	
3	.229	12	.00274
		18	
		24	
		48	
4	.204	12	.00280
		18	
		24	
		48	
5	.182	12	.00280
		18	
		24	
		48	
6	.162	12	.00291
		18	
		24	
		48	
7	.144	12	.00298
		18	
		24	
		48	
8	.128	12	.00303
		18	
		24	
		48	
9	.114	12	.00310
		18	
		24	
		48	
10	.102	12	.00318
		18	
		24	
		48	

The influence of inductance is, to a large extent, mitigated by the use of concentric conductors or by conductors twisted around each other. The effects of inductance, unless remedied, are noticeable in the increased impedance of the line and the lag of current. The nearness of the conductors in pairs is detrimental in that it causes an increased mutual induction between them.

Transposition of Wires. To overcome this difficulty it is necessary to make use of the method of transposition of conductors in installing the wires. This consists of the crossing of the conductors at certain intervals so that a neighboring pair of wires remain inductively unaffected by the variations occurring in the first pair. In the diagram (Fig. 2) are shown instances of transposition and the effects of the same, as shown by arrow heads. In the case presented neutralization will result because the transposition occurs at the middle of the lower line and its effect is therefore nil with respect to the neighboring line. The other cases are developed so that a constant transposition is indicated in the diagram. In the case of 20 wires, as illustrated, the upper and lower cross-arms of a pole line are shown with a series of transpositions systematically occurring, as the upper diagram is intended to represent. The entire process is merely the application of the first original idea, logically carried out.

Capacity of Lines. The static capacity of transmission lines can be calculated by formulas covering such cases as arise, due to the use of insulated lead-covered cables, single conductors with a ground return, or two parallel conductors constituting the total circuit. In the first case the formula gives the capacity in microfarods per mile for lead-covered cables where the following symbols are used:

K = microfarads
k = specific inductive capacity of the insulation
D = inner diameter of lead covering of cable
d = diameter of conductor
h = height of conductor above the ground
A = distance between wires,

$$\text{then } K = \frac{38.83 \times k \times 10^{-3}}{\log \dfrac{D}{d}} \text{ per mile}$$

For a semi-metallic circuit with ground return the formula is:

$$K = \frac{38.83 \times k \times 10^{-3}}{\log \frac{4h}{d}} \text{ per mile}$$

and for conductors running parallel to each other the fomula is:

$$K = \frac{19.42 \times 10^{-3}}{\log \frac{2R}{d}} \text{ per mile}$$

The capacity of a current may be controlled, as far as its effects are concerned, by the introduction of a certain amount of inductance. By this means a neutralization of one by the other is affected successfully. The relationship of the two must be such that K equals the following:

$K = 1 \div p^2L$ in which L = inductance and $p = 2 \times \pi \times f$ in which f = cycles per second and $\pi = 3.1416$.

It is obvious that a knowledge of the capacity of 1000 ft. lengths of circuits will be extremely valuable in calculations calling for a balance between the reactance of inductance and capacity.

Capacity in Microfarads and Inductance in Millihenrys per 1,000 ft. of Wire

Size B. &.B. Gauge	Microfarads	Millihenrys
0000	.00388	.282
000	.00378	.290
00	.00368	.296
0	.00358	.303
1	.00351	.310
2	.00342	.317
3	.00334	.324
4	.00326	.332
5	.00320	.339
6	.00313	.346
7	.00306	.352
8	.00300	.360
9	.00294	.366
10	.00288	.373

Conductors Carrying Power. Conductors for carrying power can only be properly estimated on the basis of their weight, strength, temperature resistance, capacity and inductance. The determination of these elements will lead to the correct commercial estimate of their cost. At its best power transmission is a financial question involving certain expenditures and returns. The degree of intelligence shown in the laying out of a power transmission system is, therefore, subordinate to the financial condition involved. It must be applied so that cooperation of one with the other will lead to the evolution of a paying equipment.

Balancing up Inductance and Capacity. A case may be presented in which the capacity and inductance are to be balanced because of the overplus of one in comparison with the other. The conditions for a balance in practice as well as theory are identical. That is to say, if 10 ohms of inductive reactance are present, they can only be balanced up by 10 ohms of capacity reactance. In other words, the conditions are as follows:

$$2 \times 3.1416 \times f \times l = 1 \div 2 \times 3.1416 \times K$$

Suppose a case is taken in which 1,000 feet of wire, or a 500-ft. run is traversed by a current of 60 cycles a second and has an inductance of .303 of a millihenry, th size being No. 0 B. & S. gauge. In this case, the

$$\text{Inductance Reactance} = 2 \times 3.1416 \times 60 \times .000303 = .114231 \text{ ohm.}$$

On this basis the capacity reactance would have to be equal numerically to balance. But this particular size of wire has a

$$\begin{aligned}\text{Capacity Reactance} &= 1 \div 2 \times 3.1416 \times 60 \times .00358 \text{ microfarad}\\ &= 1 \div 377 \times .00000000358 \text{ farad}\\ &= 1 \div .00000135\\ &= 740740\end{aligned}$$

The capacity effect is far in excess as reactance of the reactance of inductance. The formula shows that a balance is obtained when

$$p\,L = \frac{1}{p\,K}$$

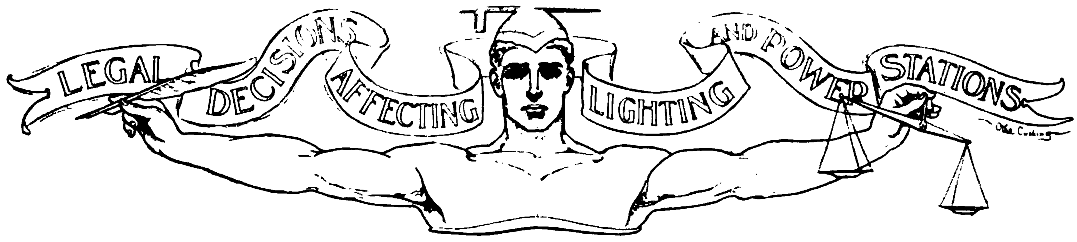
in which case

$$L\,K = \frac{1}{p^2}$$

or

$$K = \frac{1}{p^2L}$$

in which $p = 2 \times \pi \times f$ and L = the inductance in henrys.



Prepared for THE CENTRAL STATION by Colin P. Campbell, Attorney

Liability for Defective Insulation of a Lamp Causing Injury to One Who Was Warming His Hands at the Globe.

The city of Somerset owns an electric light plant, and rented or leased to Elmer Burton for compensation an electric globe with a brass socket, which was installed by it in a booth kept by him in the sale of confections. The globe was inside the booth, and so high that appellant, a boy of 17 years of age, who was employed by Burton, could only reach it by elevating his hands over his head. He testified, in substance, that, on the evening the injury occurred, it was rather cold and damp, had been raining, and, there being no fire in the booth, he put his hand up to the globe for the purpose of warming it, when one of his fingers came in contact with the brass socket, injuring him quite severely. Children and other persons were in the habit of visiting the place for the purchase of candies and nuts, and the globe was so situated that it might have been reached by a man of ordinary size standing on the sidewalk of the city. An electrical engineer, introduced as a witness for appellant, said that the lamp and socket were not properly insulated or protected, and that the dampness of the atmosphere added to the danger incident to coming in contact with it; that if it had been properly insulated, there would be no danger in handling or touching it; but that if exposed to dampness as this light was, the socket would become charged with electricity, and dangerous to handle or touch. Upon the conclusion of the testimony for plaintiff, appellant here, the court preemptorily instructed the jury to find for appellee, defendant below.

The Court said, It is argued for appellee that the condition of the lamp was unknown to the city, that it had received no request to repair it, nor had any notice that the dampness rendered it dangerous; and, further, that appellant was not required by his duty or business to handle or touch the lamp or socket, and in so doing was a trespasser, and the city owed him no duty, and, therefore, he could not recover. It was held by this court in McLaughlin v. Electric Light Co., 38 S. W., 851; 18 Ky. Law Rep., 693; 34 L. R. A., 812, to be the duties of electric light companies or persons operating such plants, at points where people have the right to go for work, or business or pleasure, to have the insulation or protection perfect; and for failure in this respect they must respond in damages.

Applying the rules announced to the facts of this case, we are of the opinion that it was error to take the case from the jury. The electric globe or light by which appellant was injured was not perfectly insulated or properly protected. If it had been, the injury would not have occurred. Appellant was not a trespasser. He had the right to be where he was; but if he had been passing along the street, and had touched the globe with his hand as he might have done, the city would be equally liable, as it committed a breach of duty in failing to have and keep this electric globe, that was placed in a position where it might be touched by persons walking along the streets, perfectly insulated. It is said by counsel that the evidence does not show that the city had any control of the globe, or that it was its duty to keep it in repair. The evidence, however, does establish that the globe was installed by the city and compensation was received by it from Burton, and this imposed upon the city the duty exacted of owners and operators of electric light plants; and it cannot escape responsibility upon the plea that the evidence did not show

whose duty it was to keep this globe properly insulated.

The judgment is reversed, with directions for a new trial.

Thomas v. City of Somerset, 97 S. W. Rep., 420.

Public Control, Revocation of Franchise (Continued).

This rule, however, does not prevent the exercise of a power of control judicially denominated as the police power of the State. It does not prevent the imposing of reasonable regulations for the public good even to cases where this may incidentally impair the franchise rights of light and power companies. Such regulations are supportable upon the ground that the company is deemed to have taken its franchise and is deemed to enjoy its rights subject to the control and regulation of the State for the general good; just as the rights of any citizen while they may not be impaired, are subject to regulation and control by the Legislature or by municipalities for the benefit of the general public and in order that the common rights of all the people may be enjoyed without interference or improper restraint, and such regulation may take the form of the fixing of rates, provision for quality and time of service and for a large number of other things, as well as general policing. All this the public may do unless the franchise of the company makes such provision os will preclude the exercise of this right by the State, as when it in specific terms authorizes the charge of certain rates or the operation in a certain manner. When this is the case the provision of the franchise is deemed a contract and will be protected just as other contract rights are protected, by the provisions of the constitution. This also suggests a very common method by which States or municipalities are enabled to control and regulate public service corporations and like companies, that is by reservation in the franchise or in the act providing for the incorporation, of power to do certain things, and even of power to revoke the franchise itself. By such a provision power is reserved to the State to revoke the franchise of the company and it may thereafter be prevented from continuing its business where this power has not been reserved. The only other method known to the law by which the franchise of a corporation may be forfeited is by a judicial proceeding, although the statutes in some States have provided peculiar remedies for this purpose; they are all referable to the ancient common law remedy of Quo Warranto. This remedy, as its term implies, is an enquiry instituted by public authority for the purpose of enquiring by what warrant a public franchise is exercised by an individual or group of individuals or corporation and lies to correct the abuse by the corporation or others exercising a public franchise of the franchise or a violation of other public law. The result of a proceeding by quo warranto may be either to entirely revoke the franchise or to restrict its use to legal limits, but its exercise for either purpose, involves a trial in court and a judicial inquiry as to whether or not there has been an abuse of the privilege concerned. As illustrative of the principles which we have heretofore enunciated, the discussion of a few cases will lend point to the rules. It cannot be doubted that under the Dartmouth College case a franchise to a lighting corporation to use any streets for the erection of poles and stringing wires as well as other grants to such corporations of public privileges are contracts within the rule of this famous case, which has heretofore been referred to. Thus in People Ex Rel New York Electric lines Co. v. Squire, 107 N. Y. 593, the unimpairable character of a franchise secured by an incorporated company under a charter authorizing it to maintain electric conductors in city streets, was recognized although not directly passed upon and it was held that such rights although of the character of contracts were subject to public regulation so long as the company's franchise rights were not impaired and invaded. This case was later affirmed by the United States Supreme Court in 145 U. S. 175. In other cases it has been squarely decided that such franchises granted to electric light and power companies are contracts, and although subject to municipal regulation, may not be impaired. Thus it has been held that the privilege of erecting and operating an electric lighting plant and of erecting poles and stringing wires in city streets, when it has been complied with is a contract within the protection of the Constitution.

Southwestern Missouri Electric Light Co. v. Choppin, 101 Fed. Rep., 123; Leves v. Newton x, 75 Fed. Rep., 884.

The city's consent to the erection and maintenance of electric light poles and wires in the streets cannot be abrogated or impaired by the mere arbitrary action of the city. Rutland Electric Light Co. v. Marble City Electric Light Co., 65 Vt. 377 This case has already been referred to, and is one in

which interference by one electric light company under a subsequent franchise with the pole and wire rights of a prior company was enjoined. The interference consisting in the placing of the later poles in such manner that the wires of the subsequent company would be lower than the wires of the earlier company and would interfere with the work of the employees of the prior company in attending to their master's lines. Consequently a privilege granted by a municipal corporation to lay a subway in a street for the use of wires used by a telegraph company is an effective contract which the city may not withdraw, impair or violate.

Western Union Teleg. v. Syracuse, 53 N. Y. Sup., 690.

A municipal ordinance granting to a corporation the right to place its wires above the surface of the street when accepted and acted upon by the company becomes a valid and unimpeachable contract which cannot be abrogated or ovedrawn except upon forfeiture judicially declared by some competent tribunal proceeding according to the course of the common law. State Ex Rel National Subway v. St. Louis, 145 Mo., 551; 42 L. R. A., 113; 46 S. W., 981.

The question has sometimes been raised owing to the overzeal of promoters in securing these franchises whether or not misrepresentations upon the part of those securing an electric lighting franchise will permit the revocation of that franchise by the municipality. It has been held in a well-considered case in New Jersey that even though the council may have been misled in passing the ordinance permitting the erection of poles and stringing wires, nevertheless it may not for this reason repeal the ordinance granting the permission when the company has conformed to its conditions and has expended money in erecting and equipping its plant and building its lines. Nor will the fact that the personnel of the company differs from that as it existed when the franchise was granted authorize such repeal. If the corporation is violating its charter or the laws of the State, proper correction may be secured by the exercise of the well-settled remedy, by quo warranto. State v. Town of Phillipsburg (N. J.), 49 Atl. Rep., 445.

Nevertheless where the city has no authority to grant perpetual easements in the streets to permit the erection of poles and stringing of wires and the record of the common council shows merely a license grant to an electric light company which has not secured a franchise from the State, the council may revoke the license and order the poles to be removed when such license was connected with a contract for municipal lighting and when such contract has terminated. Horner v. Eaton Rapids, 80 N. W. Rep., 112.

But when the terms is not specified the franchise will be deemed to have been granted for the lifetime of the corporation and before that time the city, while it may regulate in a reasonable manner the exercise of the franchise it may not compel the removal of the poles and wires. Wyandotte Electric Co. v. Wyandotte 124 Mich., 143.

Municipal Ownership—Gold Brick Finance.

Denuded of all technical drapery, one of the most popular fallacious and municipal credit destroying fads of the new century, says Mr. J. G. Boyd, in his interesting paper read before the Iowa Electric Association, is the demands from the masses for the municipalization of public utilities generally. The object of this paper, however, is to consider more particularly that department devoted to municipal ownership of the electric light plant.

As the average and "overburdened taxpayer" sits well back in his comfortably upholstered chair and contemplates with stern disapproval the magnitude of his tax bills just received, there appears before him a mental picture of the stupendous advantages (?) resulting from municipal ownership of all the public utilities. Probably he has read with more or less interest the balance sheets authorized and published under the direction of the town officials charged with the administration of the public utilities in a neighboring town, and is constrained to deplore that his bailiwick is so sadly lacking in common sense as to permit the local private company to "continue, unchecked, its nefarious career of robbing the public."

Those reports he either cannot or will not analyze. He seems content to accept with cheerful self-assurance the correctness of the exhibit therein made. He would not presume to question the ability of the power directly in charge to make a safe and proper exhibit. Yet if a "con" man were to approach him with some get-rich-quick scheme, he would, likely, arise in righteous indignation and drive the fellow from his presence. And yet, as a matter of fact, the average municipal report is entitled to but little, if any greater respect, by virtue of the fact that their composition seldom embodies more than a modicum of concrete truth.

This statement is not designed to imply that the compiler of such reports purposely garbles the facts in a deliberate attempt to mislead. Not at all. It is safe and right to believe that in almost every instance the intent was to present facts, absolute facts, and to charge the glaring omission to a lack of knowledge of the controlling factors, and which lack of underlying knowledge is exemplified in the issuance of reports, which possess absolutely no commercial value whatsoever, other than to demonstrate to the well posted man that the actuary did not understand even the rudiments of the situation.

It not infrequently occurs that the town council is composed of the representative business men of the community, hence, in such instances, it is not right or just to call into question the true aims or integrity of the council members. However, granting all that, failure is quite as frequently written under those auspices as when graft holds full sway. Does not such deplorable result dictate that elsewhere than in the personnel of the city council is to be sought the underlying cause for financial disaster, and that negative results are not, necessarily, the sole sequence of spoils?

As a rule, the members of the city council do not receive salaries of sufficient magnitude to justify continual neglect of their regular bread winning tasks, or to ignore the demands of family and social pleasures, or to suffer great, continual, self-inconveniences for the universal advancement of the manifold interests of the "dear public." If it be true that the quid pro quo is not sufficiently colossal to warrant or justify the various sacrifices demanded, then it becomes strictly pertinent to ask what right a commonwealth has to assume that its commercial ventures are to have precedence over the private interests of the council members? The slogan of the business world to-day is not so often: "How can I promote the interests of my fellow man?" as "What is there in it for me?"

A representative body live this, composed of skilful operators, need not be told that the basing of selling values upon what some other company or community is doing, does not, in itself, conduce to dividends. Probably there is not an operator present who would not make a balance sheet and determine facts, instead of blindly following the lead of the "belled wether."

When the exponents of municipal ownership give consideration to matters of this character, they are prone to cite statistics, and as they seem to feel that that sort of evidence is competent, as our lawyer friends would say, suppose we meet them on their own ground in a heroic effort to attempt to arouse a misguided public from the baneful hallucinations resulting from its pernicious "pipe dream."

A town in middle Iowa, something like thirty days ago, published its annual statement (?) of public utilities. It embraced three departments. viz: Water, Light and Heat. The water plant is entirely segregated, hence it is within the bounds of reason to readily ascertain its exact performance, yet the result is debatable, to say the least. The electric light and heat department are jointly operated, and as suitable means appear to be entirely lacking to actually determine a division of operating expenses, it is assumed that the division is made according to the best guesses obtainable.

If my analysis of the figures submitted in the report is correct, then the disbursements exceed the gross earnings as follows: Water, $1,865.20; electric light, $1,922.29; steam heat, $403.90, thus making an apparent deficit in the three departments amounting to $4,191.39. To this amount should be added an overdraft in the water department of $6,693.73. One item which will appeal to you is free lighting service furnished several manufacturing industries in the town. Such procedure might possibly have the sanction of the courts, but. be that as it may, it cuts a most pious figure in the fixed charges. Parenthetically, it might be stated, there is nothing in the report which enables one to determine whether or not any regard is had for the items covered by fixed charges.

So far this year, three previously operated municipal plants in this quite immediate vicinity have been sold to private parties. Two in our sister state of Illinois and one in Iowa. In the case of the two former plants considerable objection de-

veloped over the change, yet, judging from the papers, the rebellion was more on account of the particular methods adopted for transfer than against the accomplished fact.

Two recently published articles on municipal ownership read in part as follows: The first was headed "Municipal Ownership in New England," comments on the "Annual Reports to the Massachusetts Gas Commissioners by Electric Light Companies," stating: "The actual figures of the gas and electric light commissioners show no savings to amount to anything by the towns that have their own plants, and that they show most decidedly that the cost to the towns that had their own plants is steadily rising, while the cost to towns that purchase their lighting from a private company is steadily diminishing."

The other article was written by Henry W. Hobbs to the *Portland (Me.) Express*, and gives the cost of street lights in fourteen towns at $85.21, "Not including water used at power house, taxes or depreciation." Continuing, the gentleman stated, "A study of these figures reveals that the private consumer not only pays for street lights in his tax bill, but makes a further contribution every time he settles for lighting his house or place of business."

As having a direct bearing on the subject of street lighting it may be in order to state, that a few years ago it was my privilege to be in a position to visé the figures of cost in a case where something like 2,200 full, open series arcs, together with 1,500 commercial arcs were in service. The price for the street arcs was, substantially $75 per lamp per year on all night, every night schedule, and that at that price the central station company sustained a large loss each month. Understand, however, the bookkeeping included all fixed charges as well as operating expenses. Surely a plant pulling, approximately, 4,000 arcs should be able to deliver the service at minimum cost, yet, as before stated, it was a losing contract. Water tube boilers were employed and high grade fuel was low in price, about $1.50 per ton as recalled. The general manager was thoroughly competent and understood his business both theoretically and practically, and administered the duties pertaining to his office in a manner satisfactory to his board of directors, but was in no manner responsible for the low contract price obtaining. This formed an instance where there was no change of administration each year or two, and as a consequence the position of general manager was not menaced by "pull" or influence.

Notwithstanding all this, a certain western metropolis has stated repeatedly that it is, under municipal ownership, producing its arc service for about $55 per lamp-year, when an analysis of its own published figures indicates that the fixed charges alone exceed that amount.

Under date of March 15 the *Chicago Tribune* publishes an interesting article under the caption "City Ownership Big Problem," and states as follows:

"Municipal ownership of street car lines and electric lighting plants is a subject understood by few persons, and one on which, without deep study, the general public is not fitted to pass judgment, according to Prof. Hugo R. Meyer of the University of Chicago.

"Prof. Meyer, in an address at the university yesterday, said: 'The paralysis of Great Britain's industries has resulted from the attitude of the nation towards municipal ownership.

" 'Tens of thousands of workingmen are without employment, and the public is poorly served, as the result of the government ownership of car lines, electric light and gas plants in Great Britain.' Continuing, he stated:

" 'It is a fallacy to think that governments are munificent. They are not even intelligent. We have trusted a good many years to the corporations and captains of industry to develop industries, and the industries have been developed.' "

For years the disciples of municipal ownership have ever cited Great Britain as an object lesson and have enthusiastically proclaimed that what England has done we can do. No need for the future tense there, for, according to "Hinnisey," "We have did just what England has did," no more, no less.

"A report from the United States consul at Liverpool states that there is an unmistakable cessation in England of the tendency toward municipalization of industries. Very little is heard now of new movements in that direction, and the thoughts of the municipalities are now turned toward increasing economy of management of the public utilities already acquired.

"Probably the reaction against municipalization of industries is due to the fact that there has been an increase of $1,252,000,000 in local indebtedness in the United Kingdom in 28 years; that rates for

borrowing money have become more severe; and that the returns over the whole mass of municipal investments have not been anything like as high as was expected."

If the fundamental cause for failure could be summed up in a terse expression, it doubtless would be that the primal cause of failure is found in a lack of comprehension of the character of electric light investments. If the peculiar character of electric light investments were more fully established in the minds of investors, fewer occasions would exist for the red flag of the county sheriff. Moreover, if the general public and our state legislators understood that phase of the industry it is unlikely we would hear so much about empowering towns to regulate rates for electric services. The basic conditions are most peculiar, and well has Prof. Meyer put it when he states that: "The general public is not fitted to pass judgment." Why! just stop and think a moment—can either of you, no matter how long you have been in the business, ever promulgate that which was just and equitable to both producer and patron? Did you ever observe one which did not work a hardship to one or the other party? If you know of no such rate, does it not seem passing strange that a body of laymen, who do not know a watt from a bull's foot, presume to name a set of rates which they tell their constituents will make the property self-supporting?

Is it not your duty, gentlemen, in case you have not done so, to study this matter, and after having mastered the facts to do all in your power to set your fellow citizens right? If your people fully understand the true situation, you will have absolutely nothing to fear from the menacing perils of municipal ownership. No one but you, yourselves, together with other operators, are to blame for the delusions under which the general public rests. You understand the true situation and you should marshal your facts and present them in a convincing manner to the end that justice may obtain. It is but a few years ago that painstaking efforts were put forth to learn the exact result of average operation. Sets of questions were sent out to almost every plant in the United States and to Canada as well, asking for confidential information; and an analysis of the figures obtained evidenced that of those reporting, no less than 12 per cent. were actually losing money. With 11 per cent. the earnings barely covered fixed charges and operating expenses, and the balance were paying dividends with a minimum of 2 per cent. The average amount carried to depreciation was 9 per cent., exclusive of real estate.

Let us return to the matter of investment.

In almost every mercantile venture the capital invested has an average earning range throughout the entire work day period. In the electric light field a vastly different situation confronts the investor.

In the average sized plant the maximum investment is necessitated by, and is directly contingent upon, the magnitude and character of peak load. In this class of plants the peak load prevails not much in excess of three hours out of each twenty-four, and, as you know, calls for an investment of 100 per cent. During the balance of the night's run an investment anywhere from 25 to 40 per cent. is amply sufficient to provide the generating equipment demanded during that long burning period. Granted such treatment is true, the query arises: Well, what does that signify? The reply is: Nothing much other than success or failure. Proof is demanded. Consider, then, what next follows:

Smith and Brown desire to embark in the electric light business. They are "short" of ready cash, but "long" on tangible securities which may be hypothecated with their local bank. In looking over these securities they select several registered U. S. government bonds and submit them to their bankers. After proper inspection thereof the cashier announces: "Gentlemen, we will be pleased to pass to your credit the amount solicited." At this stage of the proceedings Smith says: "Mr. Cashier, one point we previously failed to explain and that is this, we cannot see our way to pay interest on this loan in excess of, say three hours out of each twenty-four." "In that case," replies the cashier, "it is quite necessary to make a different interest rate and settle upon a rate which will conform to the shorter earning period, and inasmuch as the three hours you name comprise one-eighth of a calendar day, it will be both proper and just to raise the rate from, say 6 per cent. to eight times that amount—48 per cent., thereby equalizing the earning conditions." "But," says Smith, "we cannot stand for that, as we will employ the money in an industry, wherein the earning period on the investment does not exceed three hours in each calendar day, and, moreover, that earning three hours acquirement is usually discounted when a certain agreed 'turning point' in consumption is reached.

and quite irrespective of the period of time involved." Mr. Cashier quietly tells you it is your business, not his, and simply because you are willing to jeopardize your savings by such methods, you have no logical right to ask him to share in the risk, and he further opines that if that is the character of investment under consideration, it does not appeal to him as the embodiment of good, sound, business judgment, for, according to your own statement of the underlying and controlling facts, your ability to eventually redeem your securities appears somewhat problematical.

Is that illustration, substantially, a true parallel? Mark you, your 100 per cent. invested has an earning range of but two to four hours a day, and if you get that point well fixed in your mind, if you are at present guilty of discounting bills for peak period service only, you need scarcely be told that unless you abandon that practice it is but a question of time until the "bogey" man gets you and you are "forced to go to work for a living."

Include all fixed charges in your bookkeeping and you will soon note that a lamp burning but one-half hour daily costs you to produce that minimum service more than 900 per cent. above that of a lamp burning all night. In the first instance, the fixed charges are all added to one-half hour's burning; and in the latter instance, the fixed charges are divided into ten or more hours.

Probably every wideawake merchant in this land knows that if he does not open his store for one day, thirty days, or six months, that his taxes, insurance and interest charges will go on just the same. Thus it also is in the electric light business. Close down your plan for any period of time and those self same fixed charges will continue right on doing business at the old stand, twenty-four hours each day and 365 days in each year. In order to emphasize this point recourse is had to another comparison:

Taking one medium sized plant with another one, the cost thereof will approximate rather closely $10 per 16 c. p. lamp for every lamp in circuit. If the plant ever turns a wheel after completion, an obligation must be charged against interest on investment. Depreciation on everything, unless the real estate is excepted. Taxes and insurance. Suppose that for the purpose of illustration we assume the total of those items in the galaxy of fixed charges at as low a rate as 12 per cent., it follows then, that if your plant never operates at all your obligation will be 12 per cent. on each $10.00 invested, amounting to $1.20 a year, or 10c. per lamp per month, for the exceeding pleasure of being the proud owner of a "juice mill" which is apt to become antiquated within one decade. Go a little further to seek a possible cause for lack of suitable dividends. Suppose, for instance, a church or lodge room wants light. Assume the requirements at 100 lamps. The service, we are all aware, will be quite incidental, and applying this method of determination, the proportion of your total investment borne by that one institution is 100 times $10.00, equals $1,000. Applying the above value for fixed charges, it is at once apparent that you must collect $120.00 per year, or $10.00 per month, before the wattmeter is ever consulted. Yet, how often do we see municipalities, and occasionally others, too, making a bad condition worse by discounting bills for that character of service for the simple reason that a large number of lamps are in circuit, and used four or six times a month, and then only during the peak period. Do such illustrations indicate in a small way the character of electric light investments? Study it well, you will soon find it is not overdrawn.

In this territory the quite usual meter rate with municipally operated plants is 10c. per k. w. hour, a selling price which will, in Iowa, with the average sized plant, dangerously approach the delivered cost, yet even that ridiculously low price is, more often than otherwise, discounted on a turning point basis, irrespective of whether or not the peak period was solely involved. When that condition obtains not only does it embody lack of familiarity with the character of the particular investment, but it also dictates a potent factor of loss.

Not infrequently the municipality's service register reveals a large number of delinquent accounts, and it is not always that when the attention of the city council is called thereto, that proper remedy is forthcoming. Another instance of unfamiliarity with the character of investment: A privately owned plant would collect those delinquent accounts or discontinue the service. Suppose the city council was to hand the accounts to the official solely responsible and direct him to apply their face value to his salary account for the current month, wouldn't Rome howl?

In the average report given out by municipalities but little enlightenment is made the citizens generally. Seldom, indeed, is a proper balance sheet forthcoming. Ordinarily the document states that

the receipts from all sources were $———, and that the expenses for operation were $————, and that the difference between the two amounts represents—in black ink, net earnings, and if in red ink, something else. Usually, if it be present each successive year, the county sheriff can tell you better than anyone else what constitutes that "something else."

If the reports of either municipally or privately owned plants were comprehensive, there would be at least two columns of figures covering the disbursements or liabilities, and another column showing the source of the total earnings. One of the two first mentioned columns would comprehend all the fixed charges which are, in part, interest on investment, depreciation, taxes, insurance (fire, casualty and boiler), and all such other items as properly come under that heading. The other column would cover the true operating expenses and include such items as are purchased from time to time, and which do not add to the inventory cost of the plant. Improvement and betterment is not one of the items for this column, but the expenses thereof (if any), belong to the first mentioned column, and the additional investment should be included in inventory. The earnings should show their source, that is, whether derived from incandescent or arc lighting service, wiring and supplies, meter rents, motor service, etc., etc. A report of that character would possess real intrinsic value and would shut the door to abuses silently tolerated at present, owing to the fact that "what is everybody's business is nobody's business."

Having taxes form a fixed charge in the case of municipal plants is, perhaps, the one item receiving more adverse criticism than any or all other items. The belief quite generally obtains that inasmuch as the town owns the plant it is ridiculous to charge taxes up against it, and to take the money out of one pocket and put it into the other. Another flagrant evidence of the ignorance of the character of investment. The town probably does not, but, nevertheless, should base its selling schedule upon what the service costs to produce. When the selling price is so determined, then the taxes become important and are a material factor in basing the cost. Besides, it makes absolutely no difference who owns the plant. The plant is in existence. It occupies a taxable location and if it were owned by a private company it would be taxed and the taxes collected; therefore, inasmuch as the town is, directly, losing the taxes, the taxes become just as much a liability as the interest.

One very deplorable lack of true comprehension in the devotee of municipal ownership is apparent in his utter failure to grasp his attitude towards himself and family, when he preaches that doctrine. If the average citizen ever "gets right" on that point, the death knell of municipal ownership, as usually obtaining, will be at once sounded. As viewed through my spectacles, the "attitude" appears to be somewhat like this:

When taxpayers, particularly the wage earners, approach the ballot box to deposit a ballot calling for municipal ownership, they seldom realize fully just what the act portends. Few realize that, in effect, it is simply placing a mortgage upon the little home, the earthly paradise which shelters their loved ones. True, it is not exactly such a mortgage as a lawyer draws up, but such an one as is provided for in the city charter, which authorizes the levy of a tax to meet the expenses of the administration; therefore, when a deficit exists, the tax assessor will increase the amount of the taxes to meet the amount of the deficit, and the tax collector will either collect the levy, or you and your loved ones will be turned into the streets with not a place to lay your weary heads. Can any regular mortgage do more?

Consider, if you please, a somewhat different picture. Suppose that a deficit does exist and that the reason therefor can be traced back to municipal lighting, have we not, then, a consistent right to ask in no uncertain language, whence came the power under which such municipalities presume to force taxayers who do not use electric light, commercially, to contribute to a deficit resulting from the municipality furnishing the service to a certain portion of the commonwealth for less than the cost of production? Moreover, is it just, is it right, is it business to make a large taxpayer who is a comparatively small user of light assist in liquidating the service bills of the heavy user of light, but who is a small taxpayer? Furthermore, suppose the taxpayers have, and so to speak, under a duress or a misunderstanding of the true conditions, paid any portion of any such deficit as above noted—that is, deficits due to the town engaging in commerce; why cannot the town be compelled to reimburse all such taxpayers with interest? The town either does or does not possess the right to perform such acts. There is no middle ground. Is it right to consider

such procedure as being tantamount to taxation without representation? If it is, and somewhat similar methods were declared wrong in 1776, what makes them right in 1905?

Taxpayers should consider this subject as sensible business men, and not as dupes of any fanatical faction. If, after having done so, their determination survives the ordeal and that determination is still for municipal ownership, they will at least have the satisfaction of intelligent procedure, predicted upon logical deductions from data obtainable, rather than as automatons pulled hither and thither by an element whose entire sincerity is, to say the least, worthy of deep analysis. If the latter element is sincere, is it not to be wondered at that they never submit to the voting element a balance sheet embodying all factors of operation and maintenance? It is not enough to excuse them through ignorance. If they don't know what they are talking about why do they open their flood gates of billboard eloquence in a more or less successful effort to destroy the town's financial status? It is just such wise men as those who force such towns as Elgin, Ill., to face a balance sheet, wherein is shown that in sixteen years the town paid $177,696.72 for 2,476 arc lamps, or $96 per lamp-year.

When a privately owned plant faces a deficit, the owners, not the taxpayers, walk the floor. Those same owners are frequently charged with obstructing a campaign for municipal ownership for no other reason than that the scheme menaces their holdings, and to a great extent that may be—probably is, and of right should be, true. No sensible person yearns to have his vested rights improperly and unduly tampered with, yet, were municipal plants in general, wisely and properly administered, but little, if any, fear would ruffle the minds of the private owners. The standing menace is based upon the almost total ignorance of underlying factors of operation. Parties who have followed the business for years are by no manner or means a unit upon certain details of operation, therefore, it is pertinent to ask: "Whence comes the supreme (?) knowledge affected by such individuals as are, obviously, unfamiliar with the simplest details of operation and whose utter lack of detailed knowledge is exemplified in the total elimination of fixed charges?"

Now, in drawing to a close, this far from complete exhibit, permit a few words more anent those baneful fixed charges. There is one very important item which has been purposely left for final treatment, in order the better to accentuate its importance. That is the item of sinking fund. Do not confound sinking fund with depreciation. The latter is simply to enable you to keep the property in correct operating condition; the former, the sinking fund, to enable the principal on the bonds to be met and the bonds duly paid. An Indiana (Mishawaka) town failed to provide a sinking fund. When the bonds matured there was no fund to be applied to their redemption and the county sheriff did the rest. The property was sold to avoid foreclosure.

The February issue of the *Water and Gas Review* has a magnificent article on this subject. It only costs 20c. New York City the point of issue, and it is "hot stuff."

Listen to this iconoclastic editorial from the Cedar Rapids *Republican* of March 29. Its thunder should reverberate from ocean to ocean:

The title is "The Supreme Objection to Municipal Ownership."

"We believe that the American people will get over this craze. The surprising thing about it all is, that so many should be enamored of it, considering the miserable record American municipalities have made with those matters that have been entrusted to municipal governments. * * * What hope is there, therefore, that the city will be careful or will be faithful and efficient upon assuming tremendous additional responsibilities and burdens? Until there has been a radical change in the character of American municipal government, ownership of public utilities is bound to be a disappointment."

Cowper has defined "Fanaticism" as being "The false fire of an overheated mind." Accepting the definition as satisfactory, cannot we, in all justice and sincerity, claim that the exponents of municipal ownership constitute a vast army of fanaticsá Is not their attitude in the premises tantamount to a tacit admission that they are suffering with "overheated minds?"

That the "fires" from which was derived the heat were "false" is apparent in some figures authorized by Mr. M. J. Francisco, a most eminent authority in such matters, who says that Toledo, Ohio, invested $1,050,000 in a municipal plant which was sold for $102,000. Austin, Texas, invested $1,700,000 in a water and light plant, which at the very zenith of its existence earned the sum of $60,000

a year at a total annual cost of only $174,000, and it is interesting to note that prior to that investment the city paid $18,000 annually for lights. Ashtabula, Ohio, paid $88,251.79 for a plant and sold it for $44,666. Marceline, Mo., invested $16,000 and sold it for an even 5 per cent. of that amount. Gravesend, L. I., evidenced its wisdom by building a $120,000 plant and then selling it for an even 4 per cent. of its original cost. Richmond, Ind., issued a balance sheet showing a clear profit in three months of $2,211.51, omitting, with an innocence which was "childlike and bland" all consideration of those useless (?) fixed charges. Possibly they were considered too insignificant to command consideration, for interest, depreciation and sinking fund amounted to but a paltry sum of $6,199.84 for the same period, and yet, in the face of all this, there are "chumps" in this great and glorious republic with nerve enough to question the sanity of the disciples of municipalization. However, if you want an exhibit which "will take the tears of all the angels to blot the record out," read up on the "doin's" of the village of South Brooklyn, Ohio, and you will cease to wonder over "the increase of crime."

The graveyards which contain the rotten carcasses of the defunct examples of municipalization cover an area of huge—yet constantly increasing—magnitude. Old Father Time has kindly and lovingly concealed under a broad mantle of forgetfulness and oblivion the last resting place of some, yet as we slowly and more or less despondently wander from grave to grave, here and there, we discern a toppling reminder of erstwhile grandeur, and as we gently press apart the obscuring entanglements of partial obliteration, we descry a somewhat faded, but still legible, municipal balance sheet, which symbolizes in mute form the transcendently glorious science of Gold Brick Finance.

$2,600 in Prizes for an Electrical Solicitor's Handbook.

Earlier in the year, as will be recalled, the Cooperative Electrical Development Association offered $1,000 in prizes for papers on the subject of the organization and conduct of new business departments suitable for central stations in cities of fifty thousand population and under. These prizes were awarded by the President of the National Electric Light Association at the Atlantic City meeting on the judgment of a special committee, since which time they have been given very wide publicity through the coöperation of the electrical technical press, as well as issues by the Association in pamphlet form.

A few weeks since the subject of offering prizes with the Coöperating Committee of the National with the Co-operating Committee of the National Electric Light Association, and it was decided to offer $2,600 in prizes for such a production. The prize money is divided as follows:

$1,000 for the Light Section, of which $500 will be awarded as the first prize; $300 as the second and $200 as the third.

$1,000 for the Power Section, of which $500 will be awarded as the first prize; $300 as the second and $200 as the third.

$600 for the Heat Section, of which $300 will be awarded as the first prize; $200 as the second and $100 as the third.

In general it is desired to secure a handbook which will be both instructive and stimulating to representatives of central stations, contractors or others who are soliciting the public for the sale of electrical service for light, heat and power.

A little pamphlet is in the course of preparation containing general suggestions for the benefit of those who will compete for the prizes, and this will be very gladly sent upon request.

A committee appointed by the President of the National Electric Light Association will judge the handbooks, or sections of the handbooks, submitted, and their decision, which will be made just before the next meeting of the National Electric Light Association, will be announced at that convention, and the nine New York drafts for the several amounts distributed to the winners.

The winning contributions, or combination of winning contributions, will be made of the greatest possible benefit to the electrical business, along such lines as may be later determined by the Joint Committee.

This affords an excellent opportunity to make a valuable contribution to the commercial progress of the art, to achieve a reputation for business progress, and withal, to be well paid for the time, thought and energy required.

The Central Station

ST. PAUL BUILDING,

220 BROADWAY, - - - NEW YORK.

TELEPHONE, 3831 CORTLANDT.

H. C. CUSHING, JR.,

MEM. AM. INST. ELEC. ENGRS.

MEM. ILLG. ENG. SOCIETY.

ASSOC. MEM. NAT. ELEC. LT. ASSN.

Publisher.

SUBSCRIPTIONS.

One Year, United States, - - - - - - $1.00

One Year, Foreign Countries, - - - - $2.00

Agents for Great Britain, S. RENTELL & Co., Ltd., 36 Maiden Lane, London.

SOLD ONLY BY ANNUAL SUBSCRIPTION.

NOTICE.

Advertisements, Changes in Advertisements, and Reading Matter intended for the next month's issue should reach this office not later than the twenty-fifth of this month.

No commissions are allowed on advertising contracts or subscriptions.

Entered at the New York Post Office as Second Class Mail Matter.

The Power Factor of Motors.

Alternating current practice naturally involves the use of alternating-current motors. And, it may be added, that alternating-current motors, whether built for single, two or three-phase currents, possess power factors whose influence upon the line to which they are connected determines its size. For instance, in order to show the relationship between the power factor in single-phase motors made by a large manufacturing concern and the corresponding efficiency, the following figures may be noted: For a quarter horse, the efficiency is 62 per cent. and the power factor 0.74; in a half horse, the efficiency is 65 per cent. and the power factor 0.75; in a five horse the efficiency is 79 per cent. and the power factor 0.85; in a ten horse the efficiency is 81 per cent. and the power factor 0.90; and in a fifteen horse the efficiency is 82 per cent. and the power factor 0.90. The power factor is the element which, with the efficiency, means a larger wire when it is low and a smaller wire when it is high.

As far as the efficiency itself is concerned, this also governs the size of the conductor, as it would in the case of a direct-current motor as well. A series of small motors, supplied with an alternating current of an average efficiency and a power factor represented by .65 or .70, would take as much more copper as is expressed by the ratio of 1 to .7 or about .4 more. In other words, a low power factor in a great variety of motors connected to a central station means a very heavy increase in copper.

If the case is presented of 100 kilowatts in motors, of an average power factor of .70, as given (though it is admitted that it may be higher than this), the increase in copper can be best understood if a specific case is given. A single motor of this type, whose lines are 500 feet apiece, that is to say, it is wired for a 500 ft. run, would represent 1,000 feet of wire. With a pressure of 500 volts and a drop of 50 volts, that is, 10 per cent., the conductor would be a No. 1 wire B. & S. gauge. If the power factor was greater, say .80 instead of .70, the size of wire would become No. 2 B. & S. gauge. On this basis it is evident that where the runs are very long, and a great many motors are to be used, it will be cheaper to use one large motor, whose power factor being large will mean less copper; or, another way out of the difficulty, and by all means the simplest, is to place the transformer in such a position that the lines are at a minimum.

The power factor and the efficiency are thus seen to be the elements which control the size of conductors. Where inefficient motors are in use, not only is a large quota of power being wasted needlessly, but if the motors are part of the day load of a station copper in excess is being employed of that called for by even ordinary practice. The selection of a site or sites for one or more transformers to be used as centers of distribution, particularly in large factories covering a great deal of ground, or in mines, is the only logical solution to a problem of this character.

Correcting Power Lines.

The difficulties existing in power lines, by which are particularly meant lines transmitting an alternating current over a distance of some miles, are of a three-fold character. They have always been more or less characteristic of such lines, and when noted as inductance, capacity and insulation, will not seem to present anything particularly new, in thus referring to them again. But it is worth while considering for a moment the difficulties, however old, under which established systems work, even if only a barely noticeable change may be the result of such a survey of the existing conditions.

The insulation question, to make the third feature of power lines the first to consider, is a broad one in the sense that insulation, as ordinarily understood, is not suited to adequately act as a protective agent against leaks, grounds and moisture. In fact, the use of very high pressures, 40,000 and 60,000 volts, is prohibitive of any but the best and most thoroughly tested insulation obtainable. At present a great measure of success has been obtained by the use of a certain grade of glazed and unglazed ware, of a well wearing and in certain respects undeteriorating character, yet which, like all porcelains, chinas or their equivalents from the kiln, are easily fractured.

The selection, therefore, is limited in this field, and the only hope of a better and more durable insulation for high-tension wires will be found in an entirely different class of material useful for this purpose. By this is meant that through the two elements of cheapness and quality are best represented by the present type of high-tension insulator, yet the comparatively frail or breakable nature of porcelain insulators is a feature militating against them to a great extent, in some instances, in the opinion of certain experts. This is not so much the case as might appear on first sight unless extraordinary conditions prevail. Very severe storms may cause destruction and overthrow the entire pole line, in which case the insulators will collapse; but this is neither a sign of weakness nor different from what would transpire with any breakable material other than porcelain in use, or its equivalent.

Raising the insulating resistance of a line may be accomplished by paying strict attention to the poles or supports in use. Preservatives of the creosote type are excellent aids in this respect, and a body of cement to surround the base of the pole may be an advantage in many cases. The idea, in other words, is not so much to figure on greater advantages at present from the insulators themselves, but from the poles. This is a suggestion that should prove of value in all cases where the earth is very damp and the possibilities of leakage great. It seems evident that though in a case where the best possible insulators are used that the market supplies, much could be done with poles of a higher resisting power, or, if of metal, of a better type of foundation at the base as described.

The correction of the inductance, it is evident, is largely a matter of transposition and distance. Yet the next fact brought forward is that the difficulty here is the effect of distance upon the conductors in either bringing them nearer or separating them more. The meaning of, or at least the conditions governing capacity, are therefore best understood in this case at once.

If the conductors are brought nearer the capacity of the line, as a whole, is immediately increased, because of the fact that in the case of two electrified bodies with a dielectric between, capacity is made greater or less, by a less or a greater distance between them. Yet, on the other hand, the nearer two conductors are together the less the inductive effect of one on the other. This being the case, it is evident that a choice must be made of one of the two, keeping the fact in mind, however, that high-tension wires cannot safely be brought together more than a limited distance.

Thus the correction of power lines is: first, by means of an improvement in the insulation; second, by a reduction in capacity; and third, by a reduction in inductance. The latter two, the inductance and capacity, however, may react upon each other to such an extent that only the balance remains between the inductance and capacity reactance. If in favor of the former, it might be possible to bring the wires safely a trifle nearer. If, the latter, it is likely that they may be readily set further apart when being designed.

The Proper Basis for Central Station Development.

Managers of central stations may well quote the proverb of Napoleon, "Those that write letters are fools," when it comes to the real practical business effort that must be made to win success in the expansion of the load of a central station. The beaten

paths in attempting this often unfruitful task are too frequently the ones easiest to follow; and for that reason the task looms up in more massive proportions than ever when pursuit of success in this or these directions proves an utter failure.

What then, it may be asked, is the proper basis for success in obtaining central station development? To this question an answer must be framed in accordance with conditions that may be classed as internal and external with respect to central station enterprises. The internal conditions are such as relate to the clerical department, the operating department, and perhaps, to be still more explicit, the manager's office. The external conditions not only include the care, repair and management of the circuits and service, but the ripeness or readiness, or, to put it more plainly, the wealth and intelligence of the possible customers that are on the list as obtainable.

In other words, it is not difficult to see that the general operation of the station must be defined as good before it is worth while attempting to get new customers, with the knowledge beforehand that they cannot be kept on account of a varying current supply and an irregular pressure at the lamps. The situation then narrows itself down to that of getting the consumer to use current, who has never used it before, or who has used it before and found, according to his standpoint, that it was either too expensive or not as serviceable as he had thought.

It is advisable, in this respect, to leave the last class of customers to the end of the canvass, as more time and money will be required for them than twice as many of the first class. It is thus evident that all the energy of the canvassing and advertising force must be concentrated upon the first class of possible customers, and the idea to be kept in mind is to get them "right," as the saying goes. How to get them "right" is thus the great question to consider in growing towns and cities, or in towns and cities in which a central station has been recently installed.

One of the most effective ways of exciting interest in the use of electricity is, without question, that of ocular demonstration. Not merely the exhibition of its use in some store window, but its intelligent demonstration before a large and, if possible, a representative audience. In other words, the most effective way is that of holding a series of lectures in a large hall, with adequate entertainment added, to which a thousand or two of the customers sought for are courteously invited to attend. This is certainly the best way to excite an enthusiastic interest, provided a competent lecturer is employed, who keeps in mind the purpose he is to serve and skilfully guides the attention and interest of his audience into the proper channels. At such a lecture certain of the principles of electricity may be illustrated and explained which, absorbing in themselves, are still the basis of the industrial applications now being made. In this manner an intelligent view of the generation, distribution, application and sale of electricity may be taken, and will, in all probability, be retained.

The cost of advertising in other ways, when postage is considered, and the cost of printing and other expenses incidental to the distribution of the printed circulars, is very high, because of the necessity for frequent repetitions of it, and, in many cases, its absolute ineffectiveness. The proper basis for the development of a central station is thus, in the writer's opinion, when given in the order of their effectiveness, as follows: First, by means of a series of intelligently delivered public lectures outlining the principles and practice found in central stations and applications of the current; second, the use of personal solicitors or a house-to-house canvass for customers; third, the use of carefully worded circulars, descriptive in a terse way, of the use and cost of electricity in business and in the home; and, finally, the circulation of letters of solicitation, half advertising and half devoted to a request for an answer, either to the station or a canvasser employed by the lighting company.

The most successful of the great lighting companies employ all the methods outlined, believing that a forcible and aggressive effort repeated systematically is the best way of winning in the end. Judging from their gains semi-annually and annually they are correct in their view of the case.

Automatic Time Switches.

The demand for a perfect and reliable automatic time switch has resulted in six different makes which have been officially approved by the underwriters. They promise to be one of the greatest factors in getting and holding new central station customers.

CURRENT IDEAS

For Furnishing More Light, Heat and Power from Central Stations

Organization and Conduct of a New Business Department Suitable for Central Stations in Cities of 50,000 Population and Under

By Fred D. Sampson.*

The unquestionable success of the pioneers in many gigantic business enterprises in this country causes the thoughtful to wonder at the almost insurmountable obstacles these foresighted "Kings of Commerce" must have encountered in the development and perfection of these mammoth institutions.

In what manner were these great commercial feats carried out? By efficient organization and its indispensable attributes, initiative and action.

The ultimate results accomplished proved that their methods must have been the correct ones. Their dealings with the public laid a foundation of unbroken confidence.

The development of these commercial enterprises was the outcome of years of perseverance and courage upon the part of the promoters. Prejudices had to be overcome, suspicion allayed by the selling organization of these successful founders.

The central station management in the past, for the promotion of new business, has been in the hands of technical graduates, with few exceptions. Men thoroughly versed in the electrical and mechanical performance of the properties were under their direct supervision.

The sale of electricity is a commercial problem, not an electrical one.

The introduction of simple, direct advertising methods will accomplish the same results for the promotion of additional business to the central station in the future as these essential methods have done for the mercantile supremacy of this country in the past.

The new business department of a central station will be the chief factor in the growth of the sales of electricity in the future—supplemented only by the quality of the service furnished.

THE ORGANIZATION.

The executive head of this department will be known as the sales manager, who shall have direct supervision of the sales of electricity—the sales force and the advertising.

This position is one of the greatest importance and responsibility, and upon the sales manager devolves the success of the entire venture; he is the "business getter"—the life of the entire department.

The organization must be imbued with the spirit of coördination; the exemplification of which must be the head of this department; he must be the spirit of enthusiasm; his executive ability paramount in the training and conduct of the sales force.

The sales force or solicitors shall comprise young men preferably with college educational training, of local social connection (the personal element is quite a potent factor in the solicitation and promotion of business).

The young men should understand the technical talking points of the product they expect to sell—its multiplicity of uses—the approximate consumption of energy in the application of electrical apparatus that may be connected to the company's mains. There are always to be found in the cities of this class, young men with technical training who have been apprenticed to some of the large manufacturing concerns, anxious to obtain the opportunity of furthering their experience by entering the service of a central station organization. Young men of this character would prove invaluable in this department, for the reason that their electrical training would make them familiar from the start with the technical features of the subjec; and, furthermore, with factory or shop experience they would be versed in the actual construction and performance of all classes of electrical apparatus, filling the dual position of salesman and engineer. In addition to the technical sales force, a young man would be employed for the clerical work in the office (some stenographic experience would be necessary in this

position). With the increasing volume of correspondence a young woman stenographer could be added.

THE CONDUCT.

Good advertising is a special appeal. It creates a special interest in what you desire to advertise.

Adherents to a single medium of advertising results in indifference; acute interest is only awakened by demonstration; the public is always ready for a novelty.

We should open the campaign with a direct appeal in the form of a return postal card to every desirable householder; names of such can be obtained in telephone and city directories, both of which give full address and occupation (information difficult to get through other sources and tedious to complete). Thus a complete alphabetical arrangement of proposed customers is procured in the simplest of manner. The postal cards would carry the name and address of the person to whom sent. Upon the reverse side printed in an attractive way, "Please answer accompanying questions." "Sign your name in full and return." Printed upon return cards would read "Sales Manager," "New Business Department, City." Upon the reverse portion such questions as the department desired answered by party addressed, together with room for signature. The return portion of these cards could also be enclosed with circular letters and other forms of literature when answers were desired, the card thus serving a double purpose.

Using a card system, the name of each person with address, date and kind of literature mailed would be filed alphabetically. Sufficient information could be kept upon this card to arrive at the exact status of each person addressed, whether promising or not. This card for filing would be made out simultaneously with the first edition of mail matter sent. In this manner a complete record could be kept. The sales manager and sales force would all familiarize themselves with the mailing list. The city divided into districts could be canvassed by the technical sales force directly following inquiries or at regular intervals.

A circular letter could be made very effective, embracing one specific each month. Plain, lucid phraseology, with practical facts, should be the essence of these letters, especially in the case of letters to contemplated power users. Experience will demonstrate that this class of service is the more difficult to secure on account of false impressions as to the economics of operating costs. These letters should be followed by visits from solicitors and later by sales manager.

Newspaper advertising is too costly to be used in addressing a class; it should be a non-partisan medium to secure the attention of the masses. Properly carried out this form of advertising is of the best. The people of more leisure read both morning and evening papers. The larger majority of possible consumers read the evening papers on account of their occupation during the day, hence advertisements should be maintained in both papers. Furthermore, the newspaper management points with pride to its progressive advertisers, reference being made in local columns in direct ratio to the expansiveness of the advertisement inserted.

The language of the advertisement should be of the choicest. "Slang" holds the attention of nobody.

Illustrated advertisements could be used occasionally as a divertisement to the usual form. The newspaper advertising would be under the supervision of the sales manager, and the forms should be changed twice per week.

The many forms of monthly bulletins or electric service booklets, illustrated, are probably the nearest approach to the ideal advertising that has been devised.

These attractively worded and illustrated bulletins are more generally commented upon when sent through the mail than any other form of advertisement; they are really works of art. Distributing by mail is a great advantage over the house-to-house or hand distribution, a much larger proportion reaching their destination by this method of delivery. The bulletins also escape the association with the "patent medicine" and "fire sale" literature.

A complete mailing lise of bulletins should be kept on filing card, in the same manner as for other literature.

Another form of illustrated advertising is that of the printed matter circulated free to central stations by the manufacturing companies introducing their many small electrical specialties, such as fans of all kinds, small motors for household uses, heating apparatus, special forms of incandescent lamps, Holophane glassware, shades, etc. These can all be had for the mere asking and could be added to the mailing list to be sent at regular intervals.

Street car advertising has not been extensively exploited, however, it would doubtless prove an estimable addition to the various systems of advertising inaugurated.

There is one uncontroverted fact; street car advertisements are always before you; you cannot get away from them. Another indisputable advantage is that of the excellent system displayed in the care and frequent change of these advertising cards. A point might arise in case the street car and the central station systems were not conjointly owned, whether this form of advertising could be adopted; especially if the street car and the gas companies were owned by the same concern.

The display feature as an incentive to the increased and more general use of electricity is probably the most effective form of advertising in vogue.

There are many ways to advantageously display the innumerable uses to which electricity can be put. A large attractive sign in front of the central station offices bearing the inscription "New Business Department" operated every night would create public interest both in the sign and in the department. A display room could be opened in connection with the general offices of the central station, where the various forms of lighting and lamps of different candle-power could be connected to circuits controlled by switches, to demonstrate to proposed customers the elementary control of electric lighting. In this connection, instructions in the reading of meters could be given by the sales force at opportune times.

An innovation could be introduced whereby all electrical contractors of unquestionable financial responsibility in the city would be furnished current free; provided that they would carry a line of electrical specialties for lighting, power and some heating, and display same in prominent location. This would be of mutual benefit and limit the quantity of display apparatus carried by the central station.

It would be irrelevant to remark that the less stock in direct competition with the electrical contractor—the central station carries, the more business it will do with correspondingly less outlay.

The duties of the staff of the new business department would be in a measure dependent upon the urgency of the specific cases requiring its attention. The roution or regular work would comprise a consultation each morning with the sales manager and unfinished business discussed and future work planned. For the convenience of the assistants the business and residence districts could be reduced to a map in sections printed on public service cards shaded by solicitor to represent territory covered each day with an epitome of results noted on reverse side. Thus the area canvassed at any specified time could be ascertained at a glance. Upon the receipt of inquiries by mail or otherwise, the acknowledgement of same would be made, stating time representative would call for an interview, complete details of result of interview recorded, as nearly as possible, same being filed in office under proper classification as to person, address and class of service contemplated. Records of this kind under the present system of public service cards are invaluable for reference, a single kilowatt is higher than in other classes of lighting. There is also a growing demand for special devices for lighting, heating and cooking, where social functions enter into the question.

Church lighting is very desirable aside from its pecuniary advantages, also by the influence it might exert among those not easily reached by other channels of advertising.

These subjects pro and con must be considered as vital statistics in conjunction with the duties of the soliciting of new business.

The relationship of the new business department to the operating management should be that of a department coming under the direct supervision of the manager of the central station.

The sales manager would be directly responsible to the manager of the company.

In all matters pertaining to the conduct and operation of this department, the sales manager would be the executive head.

Contracts made by this department would be subject to the approval of the proper authority of the company—countersigned, however, by the sales manager.

All employees of this department should be placed upon a salary basis, commensurate with their worth and to the locality. Commissions might be considered; although the equity of same is very questionable, unless solicitors were changed from time to time to equalize the advantages of canvassing in power districts.

It must be admitted that upon the general conduct of the office man being able to manipulate a vast amount of business with correctness and dispatch. The solicitors would refer to these files for informa-

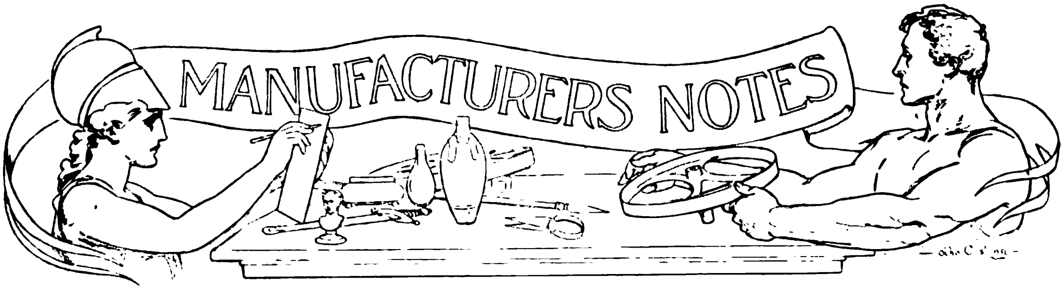
tion, not having to rely solely upon memory or memoranda.

Information regarding the operation of manufacturing enterprises using coal, gas, or other fuels should be carefully listed, statistics governing each properly compiled. Owners should be interested with the importance and economy of electric drive, the indisputable points emphasized. The necessity of indicating the horse-power of the prime mover, both with and without load, must be established without contradiction; herein lies the secret of the failure in many cases to convince possible customers to the adoption of electric power. The customer argues on the basis of capacity; load factor, through ignorance, being ignored. Demonstration here plays an important rôle. The solicitor must court the occasion to make a success.

An error easily comprehended has been committed in the mediocre solicitation of business in the past by the declination of certain classes of service. This is a mistake, especially in reference to residence and church lighting. In the first place, a well-pleased customer is the best of advertisements. Secondly, the residence lighting load is carried through a larger total number of hours per annum, especially since early closing has been established in stores and business houses. The outlay per kilowatt in apparatus is less in residence lighting. Furthermore, the net rate per anum in this department has in it the success of the company.

The policy followed must be without research. The methods above suspicion.

To the employees "courtesy and attention to everyone all the time." Avoid extremes; don't exaggerate. Patriotism and perseverance for the company.



Remote Control Rheostat Switches.

Modern switchboard engineering tends towards making the controlling board as compact and safe as possible. To this end, remote controlled apparatus with low tension wiring at the switchboard has been devised. The accompanying illustration shows a simple remote control field rheostat recently placed on the market by the General Electric Company.

This new solenoid operated rheostat switch has been developed to take the place of the bulky and expensive motor-driven switch, and aside from being smaller and simpler than the old style of motor-driven switch, the new switch has the advantage of having no momentum to carry it beyond the desired point of rest.

This automatic rheostat is arranged so as to cut resistance in and out of the circuit by a revolving arm making contact on a series of points corresponding to divisions in the resistance. The switch arm is rotated by means of pawls which engage in the knurled rim of a wheel upon which it is mounted. The pawls are operated by a solenoid plunger to which the necessary reciprocating motion is imparted by alternately making and breaking the energizing circuits of the solenoid magnets. A single pole, double throw control switch is used to close the circuit in one solenoid or the other, depending upon the direction in which it is desired to turn the switch arm. Limiting switches are provided so that when the rheostat arm reaches either end of its travel, it opens the operating circuit.

With the standard switches the operating solenoids are wound for ¾ of an ampere and 125 volts. Three capacities are made, namely: 50 amperes with 70 divisions, 100 amperes with 65 divisions, and 200

amperes with 46 divisions. The General Electric Company can also furnish special switches with solenoids wound for any standard voltage and with switches for smaller or larger capacities.

While remote control rheostats of the type described are especially built for varying the field

REMOTE CONTROL RHEOSTAT SWITCHES.

strength of generators, their use is not limited to this service but they are adapted as well for cutting in and out resistance for any purpose from a distant point, where automatic "no-voltage" and "overload release" features are unnecessary.

Indicating Plug Fuse—250 Volts.

In electric lighting installations where wires are exposed to view, it is obvious that the fittings used should be as neat and compact in appearance as possible.

Believing that the Edison plug cut-out represents the ideal design for this class of work up to 30 amperes, the D. & W. Fuse Co., of Providence, R. I., have recently devised a plug fuse embodying all the merits of their cartridge fuse, including their well-known Bull's Eye Indicator.

This indicating feature is an entirely new one with 250-volt plug fuses, although there has been a demand for it since they first invented the spot indicator on their cartridge type of fuse.

Up to this time the construction of their plug fuse was such that it was impossible to determine the blown fuse without testing the circuits, but with this new type the blown fuse is detected at a glance, as the indicator is visible at all times, thus eliminating the present practice of testing for trouble.

The operation is shown in Figures 1 and 2, Figure 1 giving the appearance of the label before the blowing of the fuse and Figure 2 showing the same fuse blown, as indicated by the appearance of the black spot within the circle.

Another important factor in the construction of this fuse is that it can be readily renewed by returning to the factory, thereby reducing the cost of maintenance.

With this fuse they have been able to meet all of the rigid requirements called for by the National

FIG. 1.

FIG. 2.

FULL SIZE.

Board of Underwriters, in recognition of which they have received their approval, and it is now listed among their approved electrical fittings of October, 1906.

The Anderson Electric Time Switch.

The object of an electric time switch is to open or close an electric circuit at any desired time of the day or night with certainty and precision. The evident value of such a device as this is so great that many attempts to produce it have been made.

It is comparatively easy to arrange a dollar alarm clock so that the springing of the alarm trips a latch and causes a spring to jerk open and close, as the case may be, some form of a jackknife switch. This primitive device has even been exploited commercially to the damage of the art, and following in its train are many others still extant and in the same category.

To be satisfactory an electric time switch must have the following characteristics:

First.—It must both open and close the circuit at the time set with absolute precision.

Second.—It must be capable of opening and closing the circuit a reasonable number of times without resetting, so as not to require attention more than once a week, thereby avoiding the necessity of setting it like a rat-trap for every event of opening or closing.

Third.—It must be capable of varying its performance, as for instance omitting to close on Sundays and proceeding with its cycle on the following week days.

Fourth.—It must be simple, rugged, and substantial, and must not stick or gag, or in any way half do its work.

Fifth.—It must be absolutely watertight and weather proof.

The Anderson time switch is all of this, and we invite your careful attention to the following description of its construction that you may judge for yourself whether or no these claims have been fulfilled.

PARTS OF A TIME SWITCH.

The parts of a first-class time switch are naturally three in number. First. The switch itself. Second. The mechanism which opens and closes it, and third, the time controlling element, which is necessarily a clock of some form.

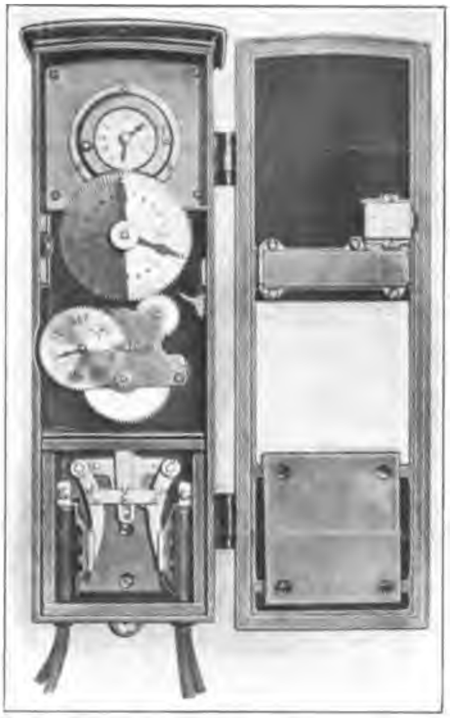
THE SWITCH MECHANISM.

The Anderson switch mechanism is well illustrated in the cut shown opposite. It consists of two pivoted arms carrying laminated contacts and arcing contacts after the fashion of approved circuit breaker construction. These arms are separated by a toggle motion, the central joint of which is thrust upward and downward by the propelling mechanism. When thrust downward the toggle motion is dead-centered and it is impossible to force the laminæ from their contact seats without exerting pressure sufficient to destroy the mechanism. There is no partial or imperfect contact possible.

The contact mechanism is housed in a slate enclosure in a separate compartment of the box and is fireproof. The lower or entering contacts are each separated from the jaws of the switch a distance of over an inch when the switch is open. The circuit is opened horizontally instead of vertically, thereby minimizing the chance of maintaining an arc.

THE PROPELLING MECHANISM.

This mechanism consists of a heavy spiral spring, equipped with two trains of gears. One of the spindles of one of these trains is equipped with a crank and connecting rod, the connecting rod being utilized to force the toggle of the switch up or down. A



THE ANDERSON ELECTRIC TIME SWITCH.

flyer on this train engages with an escapement that permits the crank to make a half revolution at a time. The reverse view of the propelling mechanism shows this crank, flyer and escapement. The connecting rod of this crank has a slotted joint with the toggle so that the parts can have some momentum before they are called upon to do any work, thus rendering the action more certain.

The second train of gears passes to the clock and

is geared into the mechanism thereof. Should this train of gears be released, the mechanism would at once run down. This feature is of great value, because it will be seen at once that the duty of the clock instead of driving anything is rather to restrain something from being driven, and instead of contributing energy to the propelling mechanism it receives energy therefrom. Connected to the mechanism in this way, the clock is really more certain of running than if propelled by its own unaided main spring.

The shaft on the last gear in the train running to the clock is hollow, and both the hollow shaft and the solid shaft within are equipped with trip dogs which can be set by means of stout hands to any desired position in relation to the gear. To facilitate this setting the gear is marked with the 24 hours of the day divided into quarters, and in order that the daylight and darkness hours may be distinguished, the gear is enameled black on half of its face.

The two cams on the back of the propelling mechanism are set by the two hands on the front, and either cam when in action will cause the mechanism to make a half revolution. The first action of these cams as they revolve is to tilt the escapement and permit a small portion of this half revolution to be made. The clock itself, a moment later, tilts the escapement back completing the half revolution. If, however, the flyer is interfered with, the crank will fail to act until the obstruction is removed. This fact is taken advantage of by gearing to the mechanism a second wheel carrying a suitable hand and cam. This second wheel revolves once in seven days, and on any one of these days can be set to interfere with the motion of the flyer, thereby preventing the switch from operating during that day. For convenience this wheel is naturally graduated to the days of the week The escapement is also capable of being moved by a hand trigger so that the switch can be opened or closed independently of the clock.

CLOCK.

A reliable clock is the heart of a time switch and the Albert & J. M. Anderson Manufacturing Company have scoured both American and foreign markets in the endeavor to secure a clock which will keep reasonably good time and will be above all things reliable, and for this purpose have adopted one of the finest imported eight-day clocks which can be secured, and have modified it for their especial needs.

ENCLOSURE.

The whole switch is mounted in a three compartment oblong cast-iron box. The bottom compartment, lined with slate, contains the switch. The middle compartment is divided so as to open from either the back or the front and contains the propelling mechanism. The upper compartment contains the clock. The whole is sealed with a heavy door, locked with a Yale lock, and rubber gasketed with a pressure lever, making the switch absolutely tight.

USES.

The use of the time switch are manifold and the users thereof great in number. The storekeeper, by its use, can close his store at six o'clock with the knowledge that at half past ten, when the theaters are out, his show windows will be brilliantly illuminated, and that at twelve o'clock the lights will be out and further expense will be saved. The switch installed on the main circuit of his establishment will assure him that at half past six every light in his building will be out, to be turned on again at opening time in the morning, thereby saving him the expense of carelessness in leaving lights turned on.

The central station man finds the switch invaluable when selling light to a municipality in certain locations for certain specific hours, thereby solving a puzzling problem of how to supply public lights from a commercial circuit without interfering with continuous service on the latter.

The switch enables him to supply electric signs or other constant loads at a flat rate for certain periods of time, and enables him to charge for the same with a precision equal to that of a meter and with more satisfaction to the customer, who can readily observe that he is receiving exactly that for which he pays.

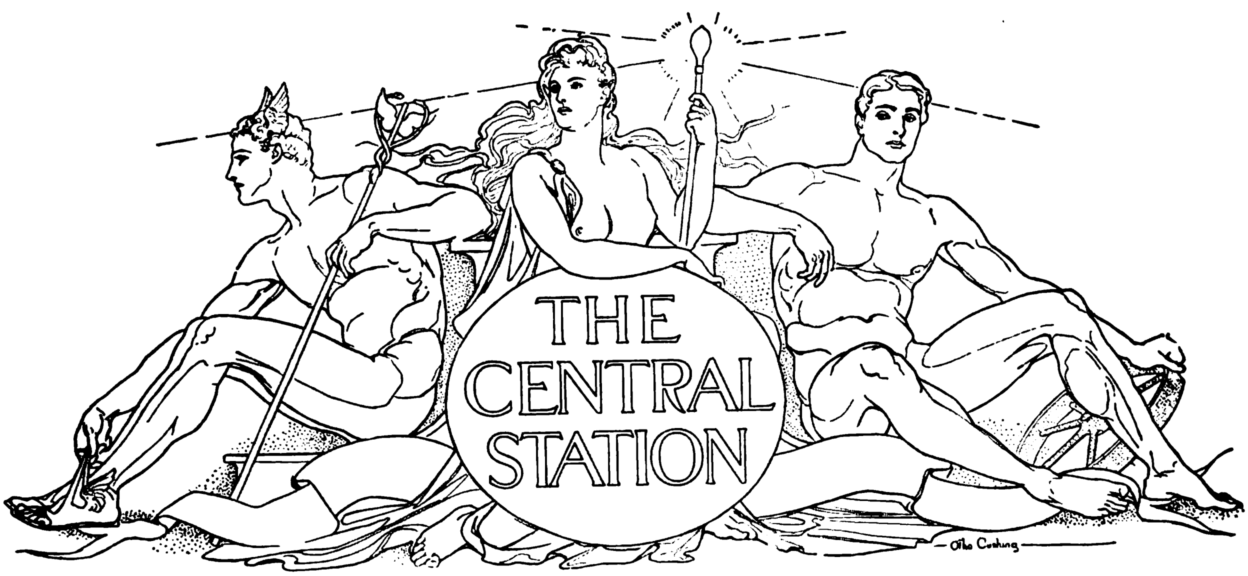
The owner of a private plant supplying power to tenants can often use this switch with more satisfaction to himself and to his tenants than he could a meter.

Institutions, having a certain time for "Lights Out" can use this switch to great advantage.

Suburban railroads can apply it for illuminating their unattended waiting stations.

Automobile charging stations will find it useful in leaving a storage battery unattended.

Hosts of other situations, where certain definite hours for current off and current on are required, will present themselves when the possibility of a reliable means is at hand.



DEVOTED EXCLUSIVELY TO THE INTERESTS OF ELECTRIC LIGHTING AND POWER STATIONS.

VOL. 6, No. 8 NEW YORK, FEBRUARY, 1907 ISSUED MONTHLY

Central Station Light, Heat and Power Principles

BY NEWTON HARRISON.

Simple Alternating Current Wiring.—To calculate the sizes of wire required for circuits carrying alternating currents, it is necessary to know what particular influences control these sizes. It is possible to enter into a consideration of them from a scientific, mathematical and abstract standpoint, consisting of deductions and conclusions represented by complex formulæ, or go with approximation straight to the goal without such preliminaries by an empirical method.

The practical man is looking for a simple way of getting results, which, if immediately applicable, need not be entirely perfect. The student and engineer are content to enter into more involved calculations in order to feel assured of absolute accuracy in their results. The best plan to pursue, therefore, in this case is an empirical one. In other words, a method which can be rapidly applied to the average practical case in which the wires are a short distance apart.

There are those, however, who will read these pages, whose knowledge of essential principles may be deficient, and for that reason a brief outline of what should be known by them ought to be highly acceptable in this instance. In alternating current circuits several influences are always at work, developed by the conductors themselves and the peculiar nature of the current they carry. The ohmic resistance of the wire is not identical with the total resistance due to the character of the current and circuit. The first is only the result of the cross section of the conductor, its length and the particular metal composing it. The second is the offspring of the rapidity of the back and forth flow of the current and what is called the "conformation" of the circuit; whether it is coiled or straight, or in other words, whether it possesses inductance or not.

A condition typically electrostatic also exists, through which conductors, whether carrying an alternating current or not, develop "capacity." From this *résumé* it becomes evident that the choice of the wire is governed by its ohmic or metallic resistance, its added resistance due to the rate of reversal of the current, its inductance, and the capacity due to its electrostatic relationship to other wires in proximity and the earth.

What Is the Inductance of a Wire.—The mere fact that a current enters a wire means that it is surrounded by a whirl of magnetism. When the current leaves the wire this whirl of magnetism also leaves the wire. It appears, therefore, around

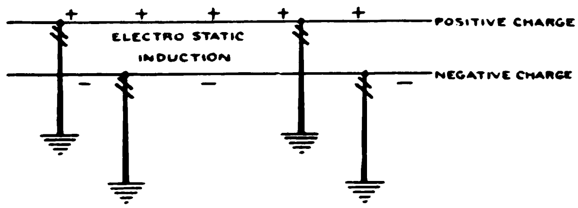


FIG. 1.—A POSITIVE CHARGE AND A NEGATIVE CHARGE IN THE WIRE INCREASING THEIR INDIVIDUAL AND NORMAL CHARGES THROUGH ELECTRO-STATIC INDUCTION.

the wire when the current appears, and disappears when the current ceases. When magnetism thus appears around a wire it develops within it an electromotive force. The reason why this is so is because a wire cannot be suddenly surrounded by lines of force without falling within the scope of a natural law. This law practically states that when lines of magnetic force around a conductor are increased or diminished, in either case electromotive force is developed. Therefore when the current is discontinued within the wire, electromotive force appears just as if the current was entering the wire.

Inductance with an Alternating Current.—When an alternating current enters a wire, the current rises and falls one way, and then rises and falls the opposite way. It is easy to picture its mode of action and to see the serviceability of such a point of view. It starts from zero, builds up to its highest value, then falls to zero. This is what is called a half cycle. During this process it has not changed in direction, but simply grown up from zero to what is called its amplitude, and then fallen again to nothing.

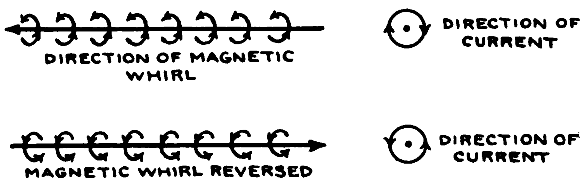


FIG. 2.—A REVERSING CURRENT PRODUCING REVERSING MAGNETIC WHIRLS AROUND THE WIRE.

It then begins to grow in the opposite direction in exactly the same manner, supplying what is called the other half of a cycle or in total one complete cycle. The point to note, is the fact, that the lines of force around the wire, grow from nothing to their greatest strength and fall to zero, and then begin again, due to the second half cycle, to grow from zero to a point of greatest density and fall to zero. Each of these operations, however, mean the development of electromotive force within the wire, due entirely to the rate at which the lines of force surround it and leave it.

The faster this happens in a second, the greater the electromotive force developed within the wire, or in other words, to employ a technical term the greater the "reactance" of the wire. This expression has arisen from the fact that the magnetism around the wire makes it *react,* in the sense that the electromotive force sending the current in, and the electromotive force developed within the wire due to the lines of force are practically opposed to each other. When the electromotive force induced in a circuit is one volt, by the current changing at the

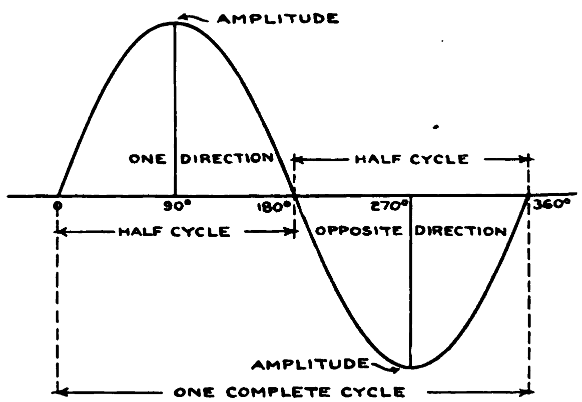


FIG. 3.—COMPOSITION OF A CYCLE.

rate of one ampere per second, the circuit is said to have an inductance of one henry.

Reactance in a Wire.—To calculate the reactance in a wire, it is necessary to perform the following operation:

Reactance in ohms $= 2 \times 3.1416 \times$ cycles per second $\times$ inductance. In other words, the reactance in a circuit, though actually consisting of an opposing electromotive force, may be considered, as far as its effects are concerned, as a resistance. It can therefore be calculated in ohms and considered in conjunction with the purely ohmic or natural resistance of the conductor.

For instance, in a circuit of 60 cycles, with an inductance of 5 henrys, the reactance would be equal to:

$$\text{Reactance in ohms} = 2 \times 3.1416 \times 60 \times 5$$
$$= 1884.96 \text{ or } 1885$$

A henry of inductance is quite considerable, and for that reason it is generally measured or given in connection with circuits, in thousandths of a henry. A line, therefore, of a certain length, say 1,000 ft. of No. 10 B. & S. gauge, having an in-

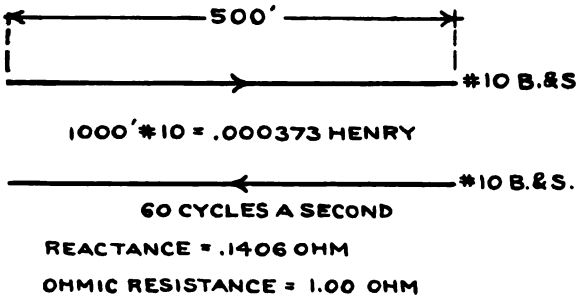


FIG. 4.—COMPARISON OF OHMIC RESISTANCE DUE TO REACTANCE.

ductance of .373 millihenry (a millihenry being equal to 1-1000 of a henry) at 60 cycles per second would have a reactance equal to 2 $\times$ 3.1416 $\times$ .000373 $\times$ 60 = .1416 ohm.

Effect of Frequency Upon Reactance.—In wiring, whether for short runs or transmission lines, it is necessary to know the effect of increased frequency (cycles per second) upon the reactance. According to the calculation, the reactance is dependent upon two factors: the frequency and the inductance. If the frequency is increased, it is evident that the reactance increases. The reactance will also increase if the inductance increases. In other words, the reactance is governed entirely by the inductance and frequency, or to put the matter in a less technical form it may be said that: the greater the number of times per second the current reverses, the greater

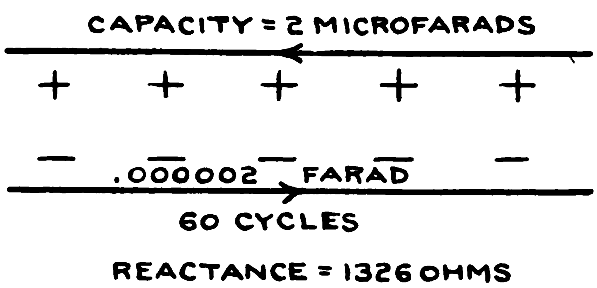


FIG. 5.—REACTANCE DUE TO CAPACITY IN A CIRCUIT.

the reactance; and the greater the number of lines of force produced around the wire by a change of current of one ampere in a second the greater the reactance. In the last case, with a frequency of 60 cycles per second the reactance was .1406 ohm; if the frequency had been 120 instead, the reactance would have been twice as great, or .2812 ohm.

Reactance Due to Capacity of the Wire.—Not only inductance, but capacity as well produces reactance though opposite in its effects. In the case of inductance, the current is retarded, due to its influence. In the case of capacity in a wire or circuit, the current is, so to speak, forced ahead. The reactance due to capacity in a wire is calculated as follows:

Reactance due to capacity = 1 $\div$ 2 $\times$ 3.1416 $\times$ frequency $\times$ capacity.

In this formula, the capacity is given in its unit, the farad; the farad, however, on account of its greatness is not used, but a millionth of a farad called a microfarad. In the formula the capacity will therefore be given in millionths, as for instance in the following example: What is the reactance in ohms of a circuit of negligible inductance, but with a capacity equal to .000002 farad or (2 microfarads), the frequency being 60 cycles per second?

Reactance = 1 $\div$ 2 $\times$ 3.1416 $\times$ 60 $\times$ .000002 = 1326 ohms.

As a general rule the capacity is comparatively low in the case of lines and outside circuits, being only .00388 of a microfarad for 1000 ft. of No. 0000 B. & S. gauge. The difference between a No. 10 and a No. 0000 wire B. & S. gauge, as far as their individual capacities go per 1000 ft., is the difference between .00288 microfarad for the No. 10 and .00388 for the No. 0000 wire.

Effect of Frequency Upon Capacity Reactance.—The influence of an increased number of cycles per second is noticeable in the case of reactance due to capacity in the reduction of the reactance. For instance, if in the above case, the frequency is increased from 60 cycles to 120 cycles per second, the denominator will be doubled in value and in consequence the value of the reactance halved.

Reactance = 1 $\div$ 2 $\times$ 3.1416 $\times$ 120 $\times$ .000002 = 663 ohms.

The reactance due to inductance increases with an increase in the cycles per second, while in this case the opposite is true. With both capacity and inductance present, the net reactance would be the difference between the two.

The Meaning of Impedance in a Conductor.—When an alternating current is flowing through a conductor it is impossible to consider the ohmic resistance as the only resistance affecting the strength

of the current, or the reactance either. Both must be considered in fact, for both affect the flow of current collectively. If they are properly considered in this respect, they are not added together but are treated as indicated in the following:

Effect of the Reactance and Resistance = $\sqrt{\text{Resistance}^2 + \text{Reactance}^2}$.

In other words, in order to place the resistance and reactance together in the proper relationship they must be individually squared, added together and their square root taken.

For instance, if the reactance of a conductor equals 1000 ohms and the resistance of the conductor equal 10 ohms, the question that would arise is: what is their net effect in ohms. Squaring each would give

Resistance squared $= 10 \times 10 = 100$
Reactance squared $= 1000 \times 1000 = 1000000$
Their sum $= 1{,}000{,}100$
The square root of the sum
$= \sqrt{1{,}000{,}100} = 1000.02$ ohms

This result 1000.02 ohms is called the impedance, or the influence which impedes the flow of current. In the case given the reactance is high in comparison with the ohmic resistance; if the case were reversed, and the resistance was high as compared with the reactance, the resistance being 1000 ohms and the reactance 10 ohms the result would be numerically the same. The fact brought to light, however, is this: that when the reactance is large compared with the resistance the resistance may be neglected.

It may be remembered that with capacity present as well as inductance, the two reactances must be subtracted from each other. For instance, if the capacity reactance also equalled 1000 ohms in the above case the square root taken would be that of

$\sqrt{(10)^2 + (1000-1000)^2} = \sqrt{10^2} = 10$ ohms

In other words when both reactances mentioned are equal only the ohmic resistance remains. A condition like this is called resonance.

The Power Factor of a Circuit or Machine.—That which is commonly called the power factor of a circuit or machine is simply a quotient obtained by dividing the power that is there by the power that seems to be there. For instance, if the power that is in a circuit or machine is 800 watts, and the power that seems to be there is 1000 watts, then the power factor is equal to $800 \div 1000$ or .8.

What is meant by the expression "the power that seems to be there" is this: that if the volts are measured with a voltmeter in the case of an alternating current flowing in a circuit with inductance, and 100 volts are indicated; and the amperes are measured with an ammeter, and 10 amperes are registered; though the product is $100 \times 10 = 1000$ watts, that is not the real power there.

To get the real power a wattmeter must be used. and if used, and it indicates 800 watts, then the operation suggested, namely, the division of the real power by the apparent power, gives the power factor .80 or 80 per cent.

The reason why power appears to be present which is not serviceable is due to inductance or capacity in the circuit. In the case of inductance the current is held back or lags behind the electromotive force. In the case of capacity it precedes the electromotive force. It is easy to realize that its practical consequence is that of preventing the two elements of power, the volts and amperes, from being coincident in their action. The lag, however, due to inductance in motors, dynamos and circuits is measured relatively in degrees; and every angle of lag means a different power factor necessarily. If the inductance is heavy, the lag is great, and the angle of lag also great. Its corresponding power factor, however, is small, because the greater the angle of lag, or the lag actually occurring, the less the value deduced from it which is the power factor itself. In other words, the cosine of the angle of lag is the power factor. If the meaning of the cosine of an angle is enquired into, it will be found that for angles of 90° or less, the greater the angle the less the cosine, or the less the angle the greater the cosine. According to this the less the angle of lag, the greater the power factor, and the greater the power factor the less the difference between the real and the apparent power.

Getting the Current in a Circuit.—If a circuit is to carry a current of 50 amperes, but its power factor is .90, then the current which must be indicated by an ammeter, before 50 available amperes will be there, must be $50 \div .9$ or 55.55 amperes. In other words, if a certain current is to be used, the power factor will be the means of calculating the current that will be there.

If a motor requires 100 amperes but its power factor is .80 then the current in the motor will be $100 \div .80 = 125$ amperes. If a case happens to be that of a line with a power factor of .95 and 200 amperes are to be used, then the current in the line will be equal to the value $200 \div .95 = 210.51$ amperes.

The power factor may therefore be employed as

the means of getting the current in any circuit, when the current to be used in it is known.

Getting the Resistance of a Circuit.—The vital point in the process of ascertaining the size of a wire is to get its resistance. To obtain this, in the case of a wire carrying an alternating current, the following steps will have to be taken.

First. Calculate the current in the circuit by means of the power factor.

Second. Find the impedance in the circuit by means of the drop and current.

Third. Obtain the resistance by means of the impedance and power factor.

To illustrate this idea, suppose the resistance of a line is to be found, whose length is 1000 ft., whose drop is to be 10 volts, whose power factor is .90, and whose active current is to be 100 amperes; the 1000 ft. representing a 500 ft. run or 1000 feet of wire in total. Then, following the schedule, the process is productive of:

First, the current, equal to 100 amp. ÷ power factor = 100 ÷ .9 = 111.11 amperes.

Second, the impedance, equal to 10 volts ÷ 111.11 amp. = 10 ÷ 111.11 = .09 ohm.

Third, the resistance, equal to .09 ohms × power factor = .09 × .9 = .081 ohm.

According to these figures the resistance sought for is practically to .08 of an ohm per 1000 feet. This being the case, it is only necessary to find out what size of wire corresponds to this resistance to accomplish the purpose in view.

Getting the Gauge Size of the Wire.—To get the gauge size of a wire from the resistance, all that is necessary is to have a list giving the resistance per 1000 feet. From this list or table the nearest size is selected having the same or nearly the same ohmic resistance for an equal length. In the following table the sizes are given for a thousand feet.

TABLE FOR REFERENCE.

Resistance per 1000 feet of wire.

Gauge Numbers. (B & S)	*Resistance in Ohms.*
0000	.049
000	.062
00	.078
0	.098
1	.124
2	.156
3	.197
4	.249
5	.314
6	.395
7	.499
8	.629
9	.792
10	.999
11	1.260
12	1.590
13	2.005
14	2.528

The last case was one which gave a resistance of .08 ohm per 1000 feet. By consulting the table, the nearest size is discovered to be No. 00. In looking over the items to be considered in connection with this particular size of wire, it becomes readily evident that its ohmic resistance alone would cause a drop distinct from that caused by the reactance. In order to be certain that this drop is what is expected, the ohmic resistance .08 can be multiplied by the current 111.11 amperes. Performing this operation gives a product of .08 × 111.11 = 8.88 volts, which differs from the total drop of 10 volts by 10 — 8.88 = 1.12 volts. The difference is due to the reactance, whose elements consist of frequency and inductance.

Gauge Size with a Smaller Power Factor.—If, in the last case, the power factor was .80 instead of .90, then the calculation will show a different size of wire. Performing the same operations gives as follows:

Current = 100 ÷ .8 = 125 amperes
Impedance = 10 ÷ 125 = .08 ohm.
Resistance = .08 × .80 = .064 ohm.

Consulting the table shows a larger size of wire than No. 00, in fact No. 000 instead, whose ohmic resistance is .062 per 1000 feet, giving an ohmic drop of .062 × 111.11 = 6.89 volts, the difference being 10 — 6.89 = 3.11 volt through reactance.

Single Phase Wire Calculations.—In single phase wire calculations, the facts to be known, to ascertain the size of wire, or in other words, the features which are assumed are as follows:

First. The total current in amperes sent over the line.

Second. The volts that are to be considered as drop.

Third. The length of wire in feet representing the circuit.

Fourth. The power factor of the line, circuit or piece of apparatus to be wired.

In single phase circuits, the current used in the

line, or the active current, as may have been noted, differs essentially from that which may be measured with an ammeter. In the following table, the value of the different currents are given, as caused by a series of power factors and the actual values or active currents corresponding to them.

Table based upon an active current of 10 *amperes.*

Active Current.	*Power Factor.*	*Apparent Current*
10	65	15.38
10	70	14.28
10	75	13.33
10	80	12.50
10	85	11.76
10	90	11.11
10	95	10.52

In this table it may be noted that the power factor determines the value of the apparent current, whatever may be the current intended for use. As the power factor increases or diminishes, the apparent current diminishes or increases. This simply means a greater or less degree of separation between the two elements of power; namely, the amperes and volts.

When the features, by means of which a calculation by this method is possible, are given, the system observed is that already illustrated.

First.—To get the apparent current.

Second.—To get the impedance.

Third—To get the resistance per 1,000 feet.

Fourth.—To get the gauge size.

In single phase circuits in contradistinction to two and three phase systems only one current is considered whether forming the basis of a two or a three wire system of lighting and power distribution.

Two Phase Four Wire Calculations.—In a two phase four wire alternating current system, the conditions existing are the same as those that may be found in a double single phase system. In other words, if the current is to be considered, it must be regarded as one half of that which would be found in a single phase system per wire.

For instance, if 100 amperes were sent over a pair of wires in a single phase system, each wire carries 100 amperes. If the same amount of power is sent over in two phase form, each wire carries only half as much or 50 amperes. Therefore in a 4 wire two phase system the current equals 50 per cent. of what it would per wire in a single phase system.

To illustrate this idea still further, suppose 1000 watts are to be sent over a two phase 4 wire system at 100 volts pressure. Without considering the power factor, the current would be 10 amperes, which is divided up between the 4 wires so that 5 amperes flows through one pair and 5 amperes through the other pair.

On this basis, in a system of this kind, the total watts must be divided by the volts to get the current, and this divided by 2 will give the current with which wiring calculations are made.

If, for instance, 10000 watts are to be transmitted 2500 feet at a pressure of 500 volts by a 4 wire two phase system, with a drop of 50 volts and a power factor of .80, the size of wire required is found as follows:

Current $= 10000$ watts $\div$ 500 volts $\div 2 \div .80 = 12.5$ amperes.

Impedance $= 50$ volts $\div$ 12.5 amp. $= 4$ ohms.

Resistance $= 4$ ohms $\times$ .8 power factor $= 3.2$ ohms.

Feet of wire $= 2500 \times 2 = 5000 = 3.2$ ohms.

1000 ft. $= .64$ ohm.

The corresponding size of wire to .64 ohm per 1000 ft. = No. 8 (see table) and the ohmic drop due to its resistance equals $.629 \times 12.5 = 7.86$ volts per 1000 ft. or $5 \times 7.86 = 39.30$ per 5000 ft. of wire.

The calculations in this case are exactly the same as in the previous case for single phase, the only difference being care in ascertaining the true value of the current in each conductor.

Three Phase Three Wire Calculations.—To calculate the size of wire required in a three phase three wire system, it is necessary to know the current flowing in each conductor. When three currents are following each other at fixed intervals the relationship between them is expressed numerically in a simple manner. For instance, if the same power passed through a pair of single phase wires, the current in each wire would naturally be much greater than when divided up between three wires. The current in each wire of a three wire three phase system is .58 of what it would be in a single phase system.

On this basis, if the watts are given, and the volts are divided into them, the resulting current multiplied by .58 will give the current in each wire of a three phase three wire system. To illustrate, suppose 10000 watts are being transmitted at a pressure of 500 volts, then the current $= 10000 \div 500 = 20$ amperes for a single phase system, but $.58 \times 20$ or 11.6 amperes three phase per conductor.

If the power is transmitted 1000 feet, the power

factor is .90 and the drop is to be 50 volts, then the size of wire according to the method is as follows:

Current $= 10000 \div 500 \times .58 \div .9 = 12.88$ amperes.

Impedance $= 50 \div 12.88 = 3.882$ ohms.

Resistance $= 3.882 \times .9 = 3.4938$ ohms.

Feet of wire $= 2000 \div 3.4938$ ohms.

Ohms per 1000 ft. $= 1.75$ ohms.

The nearest size of wire corresponding to this resistance per 1000 ft. is a No. 12 whose gauge size gives it 1.59 ohms per 1000 ft.

The drop due to this size $= 3.18$ ohms $\times$ 12.88 amperes $= 40.95$ volts, and the difference between the full drop 50 and this, equals $50 - 40.95 = 9$ volts due to reactance. The fact to be remembered in a three wire three phase system, is, therefore, the one relating to the current in the wire which is taken at .58 of what it would be in a single phase form.

Comparison of Phases.—In a single phase, two phase and three phase of the circuit conditions given the currents in each conductor are as follows:

First.—Current in a single phase system $= 1.00$ per conductor.

Second.—Current in a two phase 4 wire system $= .50$ per conductor.

Third.—Current in a three phase 3 wire system $= .58$ per conductor.

The method, as may be readily noted, is a uniform one throughout, with only one point of difference in each case, consisting of an estimate of the current in the conductor, when a single, two or three phase system is employed.

Prepared for THE CENTRAL STATION by Colin P. Campbell, Attorney

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Liability for Injury by Contact with Electric Currents While on Another's Property.

The facts disclosed in this case were: The scene of the accident was an uninclosed and unimproved tract of rough land, covered with trees, brush, and weeds, belonging to one Hubinger, constituting a portion of the premises occupied by him as a residence, and extending from a fence or wall, which constituted the boundary between the improved and unimproved portions of his tract, to the river. Over this portion of Hubinger's property, the defendant was maintaining its electric light and power wires, supported on poles, the wires being in general insulated. Deceased, a boy of 14 years of age, with two companions a few years older, went upon this uninclosed and unimproved portion of Hubinger's premises to get some zinc which they had thrown away, in order that they might sell it for junk. Deceased in some way came in contact with defendant's wire where it had been allowed to sag and where the insulation had been worn off, apparently by contact with a tree, and was instantly killed by the shock. The evidence tended to show that there were some paths running in various directions across this unimproved portion of Hubinger's property, along which persons were in the habit of passing. It may fairly be said to have been a question for the jury, under the evidence, whether Hubinger had to such an extent forbidden and tried to prevent people from crossing there as that deceased and his companions going on the land without express permission were to be considered trespassers, or whether they were bare licensees, or licensees by implied invitation. It is not contended that deceased and his companions had been directly forbidden to come upon the premises. The assigned errors argued by appellant

relate to certain special findings of the jury bearing on the questions whether deceased was so far a trespasser and without right at the place where the accident occurred that the defendant owed him no duty, and whether there is any evidence that the negligence of the defendant in allowing its wire to sag and become uninsulated at the place of the accident was the approximate cause of decedent's death.

The evidence tended to show that the portion of Hubinger's premises on which the accident occurred was so far generally used by the public that the defendant was bound to anticipate danger to some one from allowing its wires without proper insulation to sag so that persons thus using the premises were in danger of coming in contact with it and receiving injury, and the court instructed the jury that, if it was found from a preponderance of the evidence that the place where the injury occurred was so resorted to by persons generally, of which fact defendant's servants had knowledge or should have had knowledge under the circumstances, then it was the duty of defendant through its servants to exercise ordinary care and diligence to prevent such danger; and the failure to exercise such care and diligence would constitute negligence on the part of the defendant. As to the correctness of this instruction or the sufficiency of the evidence to support a verdict based on the negligence of the defendant, no complaint is made. But it is contended for appellant that in answers to interrogatories submitted to them the jury specially found deceased to have been on the premises without right.

We have, then, this situation: The jury has not especially found whether or not deceased was a trespasser, but it has found that he was not a licensee by express or implied invitation, and, therefore, if the special findings alone are to be considered, he is necessarily found to have been a bare licensee. If the instructions were binding upon the trial court in passing upon the motion for judgment notwithstanding the verdict, then the motion was improperly overruled, for the court had explicitly told the jury that if deceased was a bare licensees he could not recover. And the rule of the instruction has support in cases relating to the liability of the owner of private premises for dangerous conditions causing injury to a trespasser or mere licensee. The general rule is thus stated in 1 Thompson, Negligence, 946: "The owner of private grounds is under no obligation to keep them in a safe condition for the benefit of trespassers, intruders, idlers, bare licensees, or others who go upon them, not by any invitation, express or implied, but for their own purposes, their pleasure, or to gratify their curiosity, however innocent or laudable their purpose may be."

But if this general rule is not applicable to the case before us, then the erroneous instruction of the trial court that plaintiff could not recover was not binding upon it in ruling on a motion for a directed verdict, and, if there was any basis on which the general verdict for the plaintiff could be predicated, the court properly overruled such motion.

Therefore the action of the court in overruling the motion for judgment, notwithstanding the verdict, on account of the special finding that deceased was not rightfully at the place where the accident occurred, should not be reversed unless such finding is necessarily controlling as to plaintiff's right to recover. The general verdict is controlling as to any issue of fact, properly submitted to the jury, not covered by the special findings.

There was evidence that persons were in the habit of going across Hubinger's premises near the place where defendant allowed its uninsulated wire to sag in such a way that the safety of such persons was imperiled by it; and we do not think that the question whether such persons were, as to Hubinger, trespassers or bare licensees, on the one hand, or were rightfully on Hubinger's premises on the other, was conclusive as to defendant's liability. The controlling consideration in determining defendant's liability is whether defendant was reasonably chargeable with knowledge that persons were likely to come in contact with its dangerous wire, and might, in the exercise of reasonable care, have avoided such danger. Even as to trespassers, the defendant was charged with the duty of not wilfully or wantonly imperiling their safety, and to constitute such wantonness and indifference as to their safety as to render the defendant liable, it is not necessary that there should have been a design or intention to do them injury. There was evidence from which the jury might have found that defendant knew of the dangerous condition of his wires, and knew that persons were in the habit of going near the place of such danger, and, in support of the verdict, we are justified in assuming that the jury predicated its verdict against the defendant on this evidence. There is nothing in the special findings to negative such conclusions on the part of the jury, and, in support of the verdict, we may properly assume that the general verdict was based on such evidence.

Validity of Exclusive Grants of Franchises.

Upon this general question of the power of the city to grant an exclusive franchise, the authorities are not by any means harmonious. There are some authorities which hold to the proposition that a city may grant an exclusive franchise to a lighting company to supply the city and its inhabitants with electric light. A large number of considerations, however, enter into the question as to how far the rule of these cases can be applied, even though it be conceded that this is the rule concurred in by the larger portion of the courts throughout the United States. For example, will the franchise be construed to protect the lighting company any further than to prevent the city from taking current from some other company, competitors of the first franchise? This application of the doctrine permitting an exclusive franchise is well enough based on authority to be supportable under all the decisions. For if a city has agreed to take electricity for lighting purposes from one company for a certain period of years, it certainly ought not to be permitted to violate this contract and after creating a competitor to the first franchise give that competitor its patronage which it is under obligation by its contract to bestow upon the former. Therefore, with this rule there can be very little fault found under any of the cases. But to go one step farther, is the doctrine sustainable that a municipality may grant an exclusive franchise to use the streets and other public places for the erection of poles and stringing of wires or for the laying of mains and conduits, and then can the company which has received this grant prevent the city from subsequently granting a like franchise to another company? This doctrine when we consider the scheme of American government must at first blush strike one as rather extreme and notwithstanding the fact that many courts of respectable authority have agreed to the proposition that such an exclusive franchise is a contract which the city may not impair by the subsequent grant of a like franchise to another company. Nevertheless, the great weight of authority is that such franchise grant to the exclusion of any other grants is not a valid exercise of municipal power, and does not prevent the city from making a like grant to a competitor of the first grantee.

A further question arises as to whether if the city has granted such exclusive franchise it will be prevented because of the grant from itself engaging in the business of public lighting, which it has granted its franchise for. This also, we believe, has been ruled against the right, when the city has made a contract for a definite period, before the expiration of that period; and in favor of the city after the expiration of the period for which the city has contracted.

Another general rule, which should be borne in mind in this connection, is, that the exclusive grant must be clearly shown and will not be implied under any circumstances, or under any of the authorities, as the court, even in those jurisdictions in which exclusive grants have been upheld, universally condemn the practise and require the strictest kind of showing before they will hold the franchise to be exclusive.

Generally speaking, a city may not grant an exclusive franchise or right to use its streets for wire lines for a period of twenty years, and when such right has not been conferred either by the general statutes or by the city charter, the exercise of that power is void and the city is not prevented by the constitutional provisions forbidding the impairing of the franchise from subsequently granting a like privilege to another corporation, although the earlier grant was of an exclusive right. Clarksburg, Electric Co. v. Clarksburg (W. Virginia), 35 S. E. Rep., 994; 50 L. R. A., 142.

Where, however, by the terms of the grant the right to terminate the franchise is reserved to the common council, such grant constitutes a license revokable without cause at the will of the council and upon such revocation the council may demand that the lines be removed and the motives or influences which have lead to such revocation may not be inquired into in an action for damages because of the revocation, when the resolution was within the scope of the municipal authority. Coverdale v. Edwards, 155 Ind., 374; 58 N. E., 495.

When the franchise authorizes the stringing of overhead wires, but by a proviso requires them to be placed in a subway so far as these subways have been provided, such subways must be utilized, and the municipal authorities may remove the wires which are not placed in a subway after proper notice. The company does not gain the right to leave the wires overhead because of the initial inadequacy of the subways, but if the city authorities sell the wires which they have cut, the city is liable for the wire. Electric Power Co. v. New York, 60 N. Y. Sup., 590.

Policing the Lines.

As regards the power of the State to police a franchise under these circumstances, the power of the city over electrical subway companies and franchises illustrates better than anything else the extent to which this policing has been carried.

The statutes authorizing electrical companies to construct subways have been held void upon the ground that although the subway company may be declared to be a common carrier it is nevertheless entitled to use the streets when the ordinance or statute under which it is operating does not require it to permit other companies or persons to use its subways. The grant is accordingly held not to be for public use and, therefore, an improper use of the streets. In the same case the doctrine was further extended to require the city on pain of having its franchise held invalid to expressly reserve the power of supervision and control not only the work of excavating the streets but all matters incident to its location, construction, maintenance and use, and it was declared that the implied reservation was insufficient.

In New York Subway statutes which have been held constitutional, have provided for the construction of conduits of electric wires under streets and for the appointment of subway commissioner with power to compel a company operating electric lines to use the subways. United Lines Teleg. Co. vs. Grant, 137 N. Y., 7. An act was passed in New Jersey of the same general nature but was subseqently repealed. The police power of the State certainly extends to the regulation of electric lines; not only do policing powers touch lines where the highways or streets are in question, but they also affect such lines whenever the public interests are otherwise involved.

Thus it has been well said in a recent case in Massachusetts, the power of denial of the right to occupy the streets is a part of the local municipal power and is implied without the express conference of it in the general power of regulating and carrying for the streets and highways. Consequently, as the municipality may hold or refuse to grant a franchise it may grant it subject to such restrictions as it may choose. Suburban Light & Power Co. vs. Boston, 156 Mass., 200.

Accordingly acts have been held valid requiring wires to be placed underground in streets, and so extensive has been the use of the air for the purpose of overhead cables and wires that the easements of light and air have been seriously impaired.

These statutes as we have previously said were held valid under the police power of the State for the general good. A further extension of this doctrine has required electrical lines placed under water to be so laid and maintained as not to obstruct navigation. Blanchard vs. Electric Light & Power Co., 60 N. Y., 510.

So, also, if a line of wire is placed across a drawbridge it may be required that it be so placed as not to interfere with the work of the draw.

The public have also exercised their police power to require the maintenance of guard wires by electric companies where their wires come in contact with other wire lines and when such contact would be dangerous. Cook vs. Electric Light Co., 90 Houston, 307.

Electric R. Co. vs. Shelton, 89 Tenn., 423, is a case directly in point on this proposition and holding it to be the duty to maintain guard wires. The same effect is in McKay vs. Southern Bell Tele., Ala. 31, L. R. A., 589, where the same is held and in addition that a telephone company and a trolley company are jointly liable for an injury when they have neither of them placed guard wires.

The same effect is Block vs. Milwaukee St. R. Co., 89 Wis., 371.

Considered in this connection there might be many manifestations of the police power in the United States recounted. But we believe sufficient has been said to emphasize the general rule manifestations of which are legion that whenever the public interests require it there is authority in the public to enact and enforce such regulations as will compel these public service corporations to properly safeguard public interests.

The 30th Convention.

The 30th Convention of the National Electric Light Association will be held the first week of June in Washington, D. C.

The New Willard Hotel, the largest and most modern in Washington, will be the headquarters, and the entire tenth floor of this hotel will be given up to exhibition purposes, where the latest ideas in electric light and power apparatus and supplies will be displayed. Further particulars will be published in the March issue of THE CENTRAL STATION.

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No commissions are allowed on advertising contracts or subscriptions.

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The World's Record.

At the close of 1906 the system of The New York Edison Company supplied electric current through 66,033 meters to 2,461,261 incandescent lamps, 32,320 arc lamps, 139,168 horse-power in motors. Additional installations in storage batteries, heating appliances and other devices, brings the total installation on Manhattan Island alone to 4,762,218 equivalents of 16 candles.

The net increase for the year of 1906 was 10,618 customers, 477,590 incandescent lamps, 7,978 arc lamps, 31,483 horse-power in electric motors and other equipment, which brought the total increase of the year to 1,007,383—16 candle-power equivalents. The corresponding increase for 1905 was 525,670 equivalents.

During the month of December alone 1,607 additional customers, having 89,576 incandescent lamps, 1,148 arc lamps and 4,230 horse-power in motors and other equipment, were connected with the Edison system. The total net gain for the month was 165,008—16 candle-power equivalents.

24,873 contracts were signed—on Manhattan Island alone—for an aggregate of 2,200,000—16 candle-power equivalents. This result includes 1,191,281 incandescent lamps, more than 10,000 arc lamps and 63,359 horse-power in motors. Notwithstanding these increases and the growth of last year and the years preceding it, it would seem that Mr. Edison's observation of many years ago is as true now as it was then—that the surface has hardly been scratched.

Electric lighting to-day is not what it was even ten years ago. Then it meant simply the replacing of existing forms of illumination, of which a material percentage was oil and candles. To-day illumination means something more. It is expressed in cheerfulness and attractiveness of public places and homes and the advertising of the great commercial establishments. The latter is not confined to show windows and cases, but to that higher degree of brilliancy which characterizes the illumination of the larger stores of the city. Probably 50% of the bills for electric light are in these days properly chargeable to something other than mere illumination.

The electric sign of to-day represents a development of its own. "The Great White Way," as New Yorkers speak of Broadway, rivaling nightly the illumination of such expositions as at Chicago, Omaha, Buffalo and St. Louis, could not have been foreseen in the forecasts concerning the use of electric current.

Variety alone in the uses of the Edison system represents a remarkable growth of the applications of this silent, convenient, inexpensive energy. Not long since an advertisement was prepared to appear in the daily papers, simply mentioning each of the applications of the Edison service on Manhattan Island. The number—in excess of 300—was almost enough to fill a large page. It would be difficult, if not impossible, to name a single industry, or branch of an industry, conducted in New York City

in which the Edison system does not enter for either light, power, heat, refrigeration or some other purpose.

The Selection of a System.

Choosing a system for the transmission of power involves one or two factors that cannot be safely slurred over, particularly in the adoption of the machinery to accomplish the purpose in view.

It is evident that what is called a system, in cases of power transmission, is nothing more or less than a means of sending the power from point to point, with what may be called reasonable economy. By the very expression "power transmission," however, the choice is limited to the alternating current as a basis, with other additions more in the nature of distributing elements, than anything else. These other additions make a system appear more complex, for the simple reason that they add continuous current features to the system as a whole, which tend to and do introduce flexibility to a marked degree.

The two points, therefore, that may be safely considered as a means of guidance in the choice of a system are, first, the economy of transmission; and second, the degree of flexibility that its use involves. Modern transmission, in comparison with that of a decade ago, such as it was, calls for simplicity, in spite of the fact that the distributing center or centers cease to be so.

The selection of a certain alternating current system means the choice of a single, two or three phase plant, as the best means of economically, safely and readily transmitting electric power. A case may not call for either the two or the three phase current for the simple reason that the power to be transmitted is not sufficiently great, and the work to be done at the receiving end is only in the nature of lighting. An instance of this kind would be best interpreted as one in which a single phase current could meet all requirements. On this basis, a single phase current plant would represent the alternator, step up and step down transformers, line, poles and insulators. The motors would be small and of the well-known single phase type, if any were employed at all in this case.

The transmission of power on the other hand, for power or motor service as well as lighting, means a difference in the sense that, only two or three phase offers a proper solution of the problem. The reason why these references, so well known have been made, is largely because, in a few instances, bad engineering led to the installation of a system totally uncalled for. One glaring mistake of this kind was the selection of a 250-volt three-phase generator, to generate power for thirty-five sixteen candle-power incandescent lights, to be transmitted a distance of three-quarters of a mile. It seems evident, almost at first glance, that a 250-volt generator is not the sort of a machine to develop power for a three-quarter mile run. Even with a direct current at this pressure, it would be considered a foolhardy task to do the same thing. The choice in this case is at least a 2,000 volt generator of the single phase type, if such a choice is to be guided in any way by general principles. A step down transformer at the receiving end, would then be all that is necessary, to gain economy and flexibility, as previously stated.

Aiming at simplicity is by far a better plan than attempting to install plants that only seem to be correct, and that only from a single standpoint. The idea in any case of power transmission that should dominate all others, is the economy-cost, if such an expression can be coined. By this is meant the rather paradoxical question: what is the cost of good economy? A system for transmitting large or small quantities of power represents a case where the efficiency may be 60, 70 or 75 per cent., perhaps higher or lower, according to circumstances; if one plant has 70 per cent. efficiency, and another plant 75 or 80 per cent., including the transmission lines, an unusually high figure denoting the difference in the cost of the extra 5 or 10 per cent. would be prohibitive. In other words, the cost of economy must not be excessive, for economy that costs dearly when the installation is put in, may, with other added and natural expenses, invite financial failure even when the plant seems to be paying best.

Efficiency of Conductors in Transmitting Alternating Currents.

The summing up of the situation, with reference to an alternating current in a copper conductor, is, strange to say, a consideration of the depth to which the current permeates the conductor when it is in use. It is obviously useless to attempt to use a bulky conductor or a thin conductor, when the frequency is disregarded in either case, for the simple reason that the size of a conductor is largely con-

trolled by this factor as well as by the number of amperes to be transmitted. Many references have been made by various experts, to the distribution of current in a wire under these circumstances, all of which show the percentage of the copper in use at different frequencies. This, it is hardly necessary to point out, is an important, if not the most important aspect, conductors for alternating current transmission take, in the eyes of consulting engineers.

Mordey, on the basis of data supplied by Lord Kelvin, was the first to calculate the increase in resistance in conductors, when they were transmitting currents of high frequency, relatively. A table prepared by him showed the ratio existing between the resistance of a wire with the alternating current flowing and the resistance with a direct current flowing. For instance, if the ratio was calculated for a low frequency, it would be practically unity; but where the frequency is high it may become much more than this. A table prepared by Emmet giving the product of the frequency and circular mils and the corresponding ratio existing between the resistance with that particular frequency and its resistance with a direct current shows interesting results.

Where this product is 10,000,000 the ratio is 1.00, but where this product is 150,000,000 the ratio is 1.43 or an increase showing that the core of the conductor is not used at all. On this basis it is not difficult to realize that high frequency currents could only be transmitted by means of conductors of large cross sections; conductors in fact, that could be easily replaced by tubes of copper whose cross section of the wall would be the equivalent of the copper cross section necessary in such a case. The substance of these statements will be found to be exceedingly useful when it is realized that a wire of about one inch diameter at a frequency of 80 cycles per second, has an increase in resistance over its ordinary resistance equal to 17.5 per cent.; a conductor of diameter of a little over 1.5 inches at the same frequency for the current passing through, has an increased resistance equal to 68 per cent. of what it would be with a direct current passing through. The wire of an inch diameter, at a frequency of 80 cycles per second, whose resistance increase is 17.5 per cent., would mean a conductor wasted to that extent because of the existing conditions.

One of the advantages that may be readily pointed out on this basis is the gain due to a low frequency, as far as the ratio of resistances is concerned. The idea which must be grasped in this instance, though old, is that the current leaves the center of the wire, to a degree proportional to the frequency of the current when it is of the character of a true sine wave. The opposite influence, however, exercised in the wire, is that of the current to so distribute itself that the least loss of power results therefrom.

It is thus evident that on the one hand is found the repulsive influence derived from the frequency, and on the other hand the distributive influence due to the second influence. For these two reasons the current absolutely increases in density from the center of the conductor to the outer skin. The effect of this is to make it other than a simple case, to calculate accurately the losses in the conductor and its exact resistance. The average calculation is based upon the idea that the wire is divided up into minute conductors, each of which are exposed to exactly the same conductions in practice. That this is not the case is readily perceived by only a casual glance over the preceding statements.

The efficiency of conductors may thus be considered to be the ratio between their useful and their total cross sections. For instance, if a conductor carries a current of such a frequency that only one-half of its cross section can be used, on this basis its efficiency of usefulness would be only 50 per cent., or one-half the copper would be of no service.

The suggestion once entertained in these columns that there are instances where frequency changers would be of great service in a power transmission plant, provided they can be depended upon to hold the efficiency high, is thus seen to be applicable in any case where the loss in efficiency in the line would be serious with a high or even moderate frequency. Even a few per cent. waste in the copper is an important item, and for this reason low frequency in the line, with frequency changers at the end, would seem to offer a rational means of overcoming this difficulty.

The idea, therefore, that the availability of the copper in the cross-section of the line is not always at hand, is simply corroborative of the care and analysis necessary in every case of importance in which power is transmitted. While there are such items as the insulation of the line, which vary from day to day; the capacity of the line, which may also vary from day to day; and the other incidental elements to consider, which, as a whole, constitute the installation, it is best to establish, beyond question either way, efficiencies in whatever direction they may be obtained. By this is meant, that where effi-

ciency can be assured, because of the constants that enter into its calculation, it is best to see that in this direction at least it is established. Wherever conditions are changing, the efficiency is threatened, as may be noted in the effects upon the dividends by a load varying between wide limits and averaging up too low.

In conclusion, it may be stated, that the conductors of a power plant, are, to a large extent, the governing influence in determining efficiency and cost, in all cases where the power to be transmitted is very large and the distance great. Although conductor efficiency is really the percentage of useful or available power that gets through, the ratios of the two resistances are also within the same classification, though more in the actual nature of ratios than efficiencies. Aside from a consideration of the reactances or impedances of lines, the paramount question is that relating to first cost. It can be readily perceived that the less the amount of copper in the conductor unused, the less its cost as a conductor. This, however, is a question of frequency, which, it is thus seen, is the influence determining the amount of copper in the conductor in use. Frequency, therefore, and line cost for copper are in this respect synonymous expressions.

MONTHLY REVIEW OF THE TECHNICAL PRESS

The Demerits of Acetylene for Lighting.

By Horace Allen.

Though the demand for acetylene gas has steadily and continually increased ever since calcic carbide became a commercial commodity, less than fourteen years ago, through the development of the electric furnace, it is doubtful whether it will very seriously enter into competition with either coal gas or electricity in the field of general and economical illumination for public or domestic purposes, or for power development. This is partly accounted for by the cost of calcic carbide, for even with electric current at 13d. per unit the cost of manufacture and materials amounts to from £9 to £10* per ton at the furnace. The chief item being for current, the possibilities in the way of the price ever coming within the range of competition are very remote as long as electricity is employed in the manufacture. Added to the cost of manufacture, there is necessitated the expense of packing in hermetically sealed drums and tin canisters, owing to the great affinity of calcic carbide for moisture.

Pure acetylene gas is credited with having a faint, sweet smell, but the smell given off by all the carbide the writer has had the opportunity of examining has been quite the reverse of either faint or sweet.

The unpleasant odor arising from raw carbide upon opening the receptacle is a primary source of objection, and any neglect in the way of resealing the drum after the withdrawal of the required quantity results in the continued gradual generation of acetylene and its objectional smell. For this reason the best place to store carbide is at some considerable distance from any occupied building.

Various methods have been applied to overcome this serious drawback in the way of coating the car-

bide, and by counteracting the smell by the application of strong, sweeter smelling essences. However, such treatment has chiefly been confined to small retail parcels, for which a higher price has to be charged to cover the additional treatment.

The method of dipping the carbide into petroleum, and then into glucose, resulted in a material that was almost entirely protected from the atmosphere and free from any objectionable odor, besides having the further advantage of being much more slowly acted upon by water.

However, even this treatment does not entirely remove the tendency to continue the evolution of acetylene gas after the consumption has ceased, a very serious source of trouble in all generators using raw, or untreated, carbide. Another feature in connection with the action of carbide and water in the generation of acetylene is the amount of heat given off in the reaction.

One lb. of carbide, when brought into contact with water, gives off in its decomposition 753 B.T.H.U., which, in the absence of an excess of water, is sufficient to raise the temperature of the surrounding materials to a bright red heat. On this account, all apparatus for the generation of acetylene which is not provided with a sufficient quantity of water to ensure the dissipation of the heat evolved, is liable to become heated to a dangerous point in case of too rapid a consumption of gas. When this happens, the acetylene becomes decomposed, as is evident by the black material in the residual lime.

To a certain extent, calcic carbide resembles the electric accumulator or storage battery, for while by present processes it requires the expenditure of from 2.0 to 2.3 horse-power hours to produce 1 lb. of carbide, this may be conveyed to any distance, or stored for any length of time, if properly protected, and then the acetylene generated from it is capable of developing 1 horse-power for one hour if used for driving a gas engine; this, by the way, is not a demerit, but the reverse.

By virtue of this property it can be used to transfer energy from waterfalls in distant situations to localities where it could be turned to useful account.

The residual lime remaining from the decomposition of calcic carbide in the generation of acetylene has a very unpleasant smell when first brought out of the generator—so much so that, in the case of small apparatus, it is offensive if brought anywhere near inhabited rooms. The sludge settles down into a more or less solid mass if left to accumulate, and is somewhat difficult of removal, though it is claimed that when the carbide has been coated with glucose the lime is chiefly rendered soluble; this claim is generally more theoretical than actual, owing to the small proportion of glucose employed.

To turn our attention now to acetylene, there is no doubt that the light is of high quality, both in regard to illuminating power and its preserving the natural colors of materials, etc.

A drawback which has given considerable trouble is the necessity for a very fine orifice in the burner; it took a considerable period of time for the devising of a suitable burner, but even now, while the jet is of such small dimensions, it is liable to be stopped by the slightest particle of dust, or, on the other hand, carbon becomes deposited and a heavy smoky flame results.

To prevent the deposit of carbon at the orifice of issue from burners, a very common source of trouble, the device of providing duplicate orifices at such an angle that the two issuing jets are made to impinge upon each other and form a clear flat flame, was claimed to be successful.

This class of burner found much favor as an improvement over the single jet, but it not unfrequently happens that some slight particle of dust lodges in one of the jets, and deflects the flow of gas to such an extent as to prevent the two jets meeting centrally; the result is a very unsatisfactory flame, which can only be rectified by inserting a fine needle or wire into the clogged orifice. This would seem to be a very simple matter, but it must be borne in mind that the burner goes wrong just when the light is required, and it is necessary for the acetylene gas tap to be closed and some other light obtained to enable the clearing of the burner to be effected, owing to the minuteness of the hole in the burner and its angular direction; to insert the wire in the orifice in most burners is quite on a par with threading a needle with the eye in a rather inaccessible position.

Some burners have the orifices in such a position as to render it a very delicate matter to clear them on their becoming clogged, but the simplest way to overcome the trouble is to provide spare burners, it being an easier matter to change the burner than to probe it *in situ*.

While ordinary coal gas, in course of time, reduces leakage, through deposit, this is not the case with acetylene, so that all joints must be thoroughly sound from the first.

In regard to leakage, the unpleasant distinctive odor of impure acetylene has the advantage of quickly indicating the existence of a leak and its locality. When the gas is purified properly there is less evidence, and therefore greater danger, from this source of trouble.

Owing to its high specific gravity, 0.9, or twice that of coal gas, it does not so readily diffuse and pass away; and although the smallness of the jets renders the volume passing out in a given time considerably less than in the case of a coal gas burner, though it must be borne in mind that the pressure is usually about twice that required for coal gas, the escaping gas hangs round and tends to form an explosive mixture which would do considerable damage if even a soldering bit or glowing cigarette should be brought near, the ignition point being only 896° F., while so small a proportion of acetylene as 3.5 per cent. forms an explosive compound with air, as compared with 6 per cent. with coal gas.

It is claimed for acetylene that its vitiating effects are only about one-eighth those of coal gas flame, and that its heating property is very slight, but it must be remembered that the heat given off by an ordinary gas flame or incandescent burner has a great ventilating effect, so that the impurities given off will also be carried away as long as there is an outlet.—*London Electrical Review.*

CURRENT IDEAS

For Furnishing More Light, Heat and Power from Central Stations.

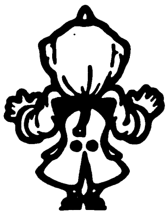
THE NEW YORK EDISON COMPANY

Developing the Electric Sign Business in New York.

By E. A. Mills.

Mgr. Sign Dept., N. Y. Edison Co.

The electric sign as a factor in central station load is becoming more important every year. While a short time ago but few electric signs were seen and these of poor construction and worse design, now there is hardly a central station in the country which does not boast of some sign equipments as part of its installation. The public has not been slow to recognize the benefit to be derived from electric signs in an advertising sense, and it seems that the question of developing the sign situation has rested



more with the public and less with the central stations than should be. This is a circumstance which should not exist, particularly as the electric sign is,

ONE OF THE BRILLIANT PARTS OF 125TH STREET—MADE SO BY THE EDISON SYSTEM.

as a general thing, a long burning equipment, which, while it may come in on the peak still goes on further than this, tending to fill in the dip in the load curve after the usual peak has passed. Then again the electric sign in view of its presence always before the public serves the purpose of mutual benefit to both the consumer and the supplying company; the former by having his name or business outlined in brilliant letters and the latter as a constant reminder that the central station is behind all this. In inaugurating a sign campaign the services of competent solicitors should be secured. These men should be thoroughly familiar with all phases of the sign situation as regards operating cost, design, construction and erection cost of the sign itself. Coupled with this should be an active follow-up system employing letters so written that the subject will be placed plainly and convincingly before the "prospects" and the letters should have in all instances the general outline of the personal letter. The advantage of this over the old sterotyped follow-up material can hardly be estimated. If a man is given the impression that he is worthy the consideration of a large corporation as an individual rather than one of a large number taken as a whole, the personal feeling engendered is in many instances the means of securing business where no other method would prevail. These letters should be alternated with descriptive matter, pertaining to signs in the shape of marked bulletins and also special sign pamphlets got out for the purpose. In addition to this newspaper advertisement of the highest character should be employed. All slang phrases and catch words should be avoided. The subject should be placed before the public in a straightforward and convincing manner and in such a shape that the same may be thoroughly understood. Perhaps the most potent factor in the introduction of

BILL-BOARDS ON BROADWAY ILLUMINATED BY CONCEALED ELECTRIC LIGHTS.

electric signs is the example which should be set by the central station in employing electric signs on all of their buildings and sub-stations as well as

district offices, etc., and in addition to this prominent sites should be secured along the business arteries,

and particularly in the theater districts where the signs will be before the public when they are not in the hustle and bustle of a business mood, but

rather in a more receptive condition for suggestions in this line. The example set is perhaps the best proof the company can offer, that it is a firm believer in the policy which it preaches. The signs may be made in such shape that the wording may be changed at slight expense and the substitution of colored lamps, occasionally, may add to the attraction. There is hardly a business but can use an electric sign to advantage, and while every storekeeper may not be able to afford a large block letter sign, there are numerous smaller types such as the so-called panel sign, which can be operated very economically. While the general outline of these is more or less similar, still by the virtue of being able to paint the panel itself in any design and color as well as type of letters and languages selected by the

consumer, the same lends itself particularly to the small business men. Perhaps the best method to follow in pursuing a sign campaign is to have the solicitor make the original call pointing out the advantages to be derived from the use of an electric sign. Should the prospect not show any great interest in the matter at the time, his name should be forwarded to the follow-up department, and the system of letters should be started. The solicitor may make occasional personal calls to ascertain the present mood of the prospect and our experience has been that if a sign is not eventually ordered still the impression made on the customer, through the agency of the personal nature of the letters ad-

dressed to him is such that electricity in some form or other is usually installed. A campaign of this kind will net remarkable results. But as in any other business where a desired end is to be attained the campaign should be vigorously pushed from start to finish. The following are samples of a first, second and third letter used by the New York Edison Company in "following up" calls made by their solicitors.

First Letter.

In these busy times, people will not take the trouble to hunt around for your sign, to see if you are still in business.

If you have an electric sign, your place can be distinguished after dark for blocks, and it will be your best advertisement.

Should your old customers wish to send you new ones, and you have no electric sign to guide them to your door, the chances are that someone with an electric sign will win them, and you will lose.

The cost is smaller than you think. The enclosed card wili bring our agent at your convenience to tell you all about it.

Yours very truly,
Arthur Williams,
General Inspector.

Second Letter.

If you notice that your neighbor is doing a larger business than you there must be a reason for it.

If his establishment is no better than yours, it must be that he attracts more people to his door than you do.

REPLY POST CARD INCLOSED WITH LETTERS.

One of the surest and most inexpensive ways to attract the after-dark crowds is to have an electric sign.

The cost of the sign with twenty-four incandescent lamps is 7c. an hour, and if you run it for four hours it will cost only twenty-eight cents.

Our expert will be pleased to call and explain all about it, if you will return the enclosed card.

Yours very truly,
Arthur Williams,
General Inspector.

Third Letter.

If you should hire a man to hand out cards with your name on them to the crowds that pass your

door, you would perhaps secure a few new customers.

But this man, no matter how hard he may work, can only reach a few of the many people who pass within sight of your establishment.

The cheapest and surest way to catch the eye of everyone, near or far, and let them know where you are, is to use an electric sign.

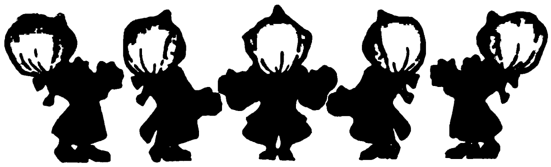
Many methods of advertising have been tried of late, but none seem to have grown as rapidly as the use of electric signs.

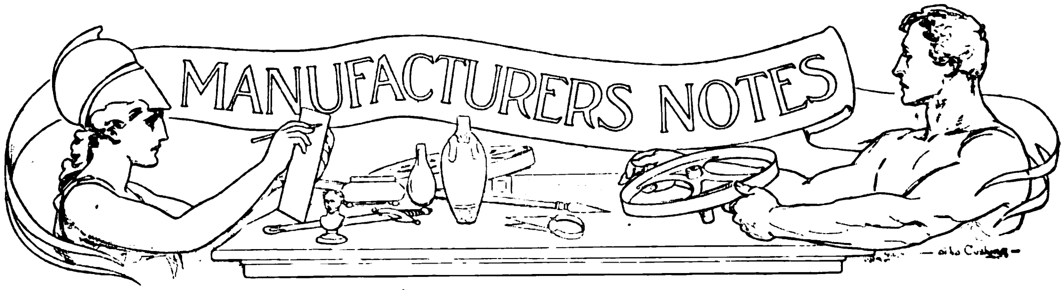
By returning the enclosed card you can have an expert from this company call on you to explain anything you may wish to know.

Yours very truly,

ARTHUR WILLIAMS,

General Inspector.





Minneapolis Steel & Machinery Co., of Minneapolis, Minn., manufacturers of the Munzel Gas Engines and Gas Producers, have recently opened a new office at 1300 West 11th street, Kansas City, Mo., under the management of Mr. Louis Bendit, who will have charge of the sales in this territory of their gas engines and suction gas producers.

Benjamin Electric Manufacturing Co., of Chicago and New York, manufacturers of the Benjamin wireless clusters and lighting specialties, have issued a very complete 64-page catalog and price list illustrating their complete product, and will be mailed to anyone upon request.

The 1907 edition of "The Insulator Book," known as Catalog No. 9, has just been issued by the Locke Insulator Manufacturing Co., of Victor, N. Y. This book also illustrates and describes their high potential glass insulators as well, and also their brackets, cross arm braces and insulator pins, all of which have become standard in high potential transmission practice.

Dossert & Co., of New York City, have issued a new 24-page illustrated catalog and price list of their Dossert solderless electrical connectors, and cable joints, for standard or solid wires and cables. The Dossert joints, described in this new circular, are meeting with tremendous success in central station practice, superseding as they do the old, time-consuming, costly and clumsy method of soldering cables, it requiring but a few moments to connect the largest sizes of cables with these joints, where it formerly took hours. Every central station man

should write for this new catalog, which also gives a list of the most prominent central stations in the country which have adopted this style joint.

The display of beautiful electric and gas table lamps by McKenney & Waterbury Co., 181 Franklin corner Congress street, Boston, Mass., is one all should see; it includes most beautiful effects to meet all decorations, especially the new Amboy Art Glass effects, making suitable wedding and holiday gifts. It is without doubt one of the largest displays in the United States.

The town of Brookhaven, Miss., has recently awarded a contract for a new municipal lighting plant to consist of one 200-kw. and 100-kw. alternating current generators to furnish lighting and power for the street lights, etc. The contract for the generators were secured by the Crocker-Wheeler Co., of Ampere, N. J. The ratings of these two generators which are to be furnished are as follows:

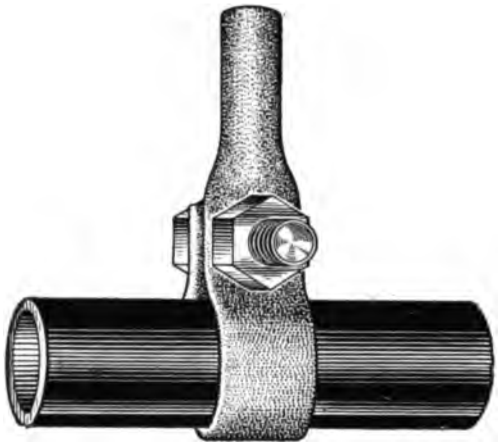
1-200-kw. engine type alternating current generator; 3 phase, 60 cycle, 2300 volts 200 r. p. m. and 1-100-kw. belt type alternating current generator, 3 phase, 60 cycles, 2300 volts, 700 r. p. m. A 13-kw. generator is to be furnished as exciter for the 200-kw. unit and a 2½-kw. generator is to be furnished for the belt type generator. This will give the plant a capacity of 300 kw. alternating current.

The Pettingell-Andrews Co., of Boston, one of the largest electrical supply houses in New England, will act as agents and distributors for the Buckeye Class A Lamps, and the new Buckeye Gem Lamps, manufactured by the Buckeye Electric Co., of Cleveland, Ohio.

We have noticed with much interest, in the January issue of the CENTRAL STATION, the announcement of the Coöperative Electrical Development Association, offering $2,600 in prizes for material for a solicitor's hand book. Under Division 2 in the pamphlet sent out by the Association, we notice that Section 1 is devoted to Illuminating Engineering. We wish to state through the columns of your paper that to any persons who desire to try for these prizes and wish information on the subject of Illuminating Engineering, we should be very glad to assist them in every way possible, offering the services of our Engineering Department for this purpose.

Yours truly,
HOLOPHANE CO.,
227 Fulton street, New York.

Novelty Electric Co., of Philadelphia, Pa., are meeting with big success with their new "Griptite" ground connection clamps, which are made of rolled copper tubing (see illustration), in sizes to conform to the diameter of standard piping from one-half to



"GRIPTITE" GROUND CONNECTION CLAMP.

three inches. These ground connection clamps being made of one piece of copper, the tightening of the bolt insures a perfect electrical contact at all points on the pipe. These clamps having a rounded edge, no injury could result to the sheathing of cables when used for grounding same. The hollow tube to which the ground wire is soldered takes any size copper wire up to and including No. 4 B. & S. The above company has just gotten out its new price list, which will be sent to any electric lighting and power station upon request.

On account of the great increase in demand for the staple specialties manufactured by the Chase-Shawmut Company, and the consequent need of more room and machinery in their factory, they have sold out their entire patented theater switchboard interests to James S. Pennefather, of New

York. The Chase-Shawmut Company ask for Mr. Pennefather a continuance of the liberal patronage heretofore bestowed upon them.

With more space and machinery the Chase-Shawmut Company are better equipped than ever for giving prompt attention to the orders they may receive.

The Chase-Shawmut Company have just received their new Bulletin No. 36, which they are distributing to the trade. This is a twelve-page pamphlet in which is listed all of their lines of fuses and fuse fittings.

The new N. E. C. single pole barrier porcelain bases are now on the market. This line includes both the 30 and 60 amp. classes for 250 and 600 volts.

The double and three pole 100 amp. N. E. C. porcelains are listed here as well.

In the last page is listed the Shawmut Extended Terminal Fuse, which they have recently put on the market. These fuses fit any Type A Block of Noark, D. & W. or Shawmut manufacture, and are becoming very popular with the jobber.

Atlas Engine Works, of Indianapolis, Ind., have just issued their general Bulletin No. 134, of illustrations and specifications of their various styles and sizes of engines and boilers for every class of work. The bulletin contains one or more illustrations of every object, with the most complete data concerning the particular class of engine and boiler illustrated. The Atlas Engine Works are the largest exclusive builders of steam engines and boilers in the world.

The Babcock & Wilcox Company has bought from the Stirling Consolidated Boiler Company, as of December 31, 1906, its American property and interests, including all accounts and bills receivable, and has assumed its obligations and will execute its orders and contracts for boilers and appurtenances for installation and use in the United States.

The plants thus purchased will be operated in the future by the Babcock & Wilcox Company under the name and style of "The Babcock & Wilcox Company (Stirling Department)," and will be operated under the direct charge and management of the same gentlemen who have operated The Stirling Consolidated Boiler Company. The gentlemen who have been connected with The Stirling Consolidated Boiler Company in its sales department will be associated with The Babcock & Wilcox Company in similar capacities.

The Babcock & Wilcox Company (Stirling Department), will manufacture the Stirling, Aultman & Taylor and Cahall water tube boilers and appurtenances heretofore manufactured by The Stirling Consolidated Boiler Company.

The Westchester Lighting Company serving a large residence and suburban section extending from Long Island Sound to the Hudson River and from the Borough of the Bronx to Tarrytown, has a modern central station plant at New Rochelle, the principal feature of which is an Allis-Chalmers steam turbine generating unit now being installed. The electrical power generated here, supplying the towns and villages connected to the comany's system, is three phase, 60 cycles, 13,200 volts and is used mainly for lighting purposes. The power house is of steel and brick construction, supplied with an equipment of six water tube Sterling boilers, 250 hp. each, in three batteries, and two Babcock & Wilcox boilers of 524 hp. each, which furnish the steam power for the turbine and engine equipment. Coal is brought up the channel in barges to the company's docks, where it is hoisted and conveyed by automatic coal handling devices to a bin of large capacity situated outside the power plant. Coal is conveyed from the bin to steel charging cars through chutes, the cars running on tracks directly to the furnace doors in the boiler room.

The main generating units are operated condensing, the reciprocating engines and the new Allis-Chalmers turbine being equipped with jet condensers. The condensing water is taken from Echo Bay through a large suction pipe which is connected through a continuous service foot valve. The 1500 k.w. Allis-Chalmers steam turbine unit is provided with an interesting condenser arrangement.

The new turbine unit has been added to the station equipment to take care of the largely increased demand for current resulting from the increased population of the district. The electrification of the lines of the New York Central and Hudson River

Railroad, and of the New York, New Haven and Hartford Railroad, both of which run through the area fed by the Westchester Company, have brought with them a new impetus to the growth of the district.

The new plant of the Iola Portland Cement Co., at Dallas, Tex., is notable for the fact that it will have the largest producer gas power installation in the world. At other plants of the Iola Company, both gas engines and steam engines have been employed, so that in selecting the type of prime mover for their new plant, it was with a knowledge of the capabilities of the respective powers, and their decision was influenced by the saving in fuel consumption that was possible by the adoption of gas for power purposes.

The Loomis-Pettibone gas generating system, built by the Power and Mining Machinery Company, will be furnished in three units having a total capacity of 4,500 h.p. Bituminous coal and Texas lignite will be the fuels used, the Loomis-Pettibone system being adapted to the gasification of either fuel without changes in the apparatus, and the resultant gas is guaranteed to be fixed, clean and suitable for use in gas engines.

The Snow Steam Pump Works of Buffalo will furnish for this plant, four of their single-tandem double-acting gas engines, each with a normal capacity of 1,100 B. H. P. These engines will be direct connected to alternating-current, 25-cycle electric generators of 810 kw. capacity each, and will operate in parallel.

Continuous operation, twenty-four hours per day, seven days per week, is required of the power plant.

High efficiency is promised by the builders of the power apparatus, and their guarantees of a kilowatt per hour at the switchboard from 1½ to 1¾ lbs. of bituminous coal or from 2½ lbs. of lignite, when operating at three-quarters to full load, assures the Cement Company of cheap power.

Experiments are now being conducted by the Engineering Department of the Sunbeam Incandescent Lamp Company, on Tungsten Metallic Filaments, and as a result of recent developments, the Western Electric [illegible] nt [illegible] ht be [illegible] e in position to furnish these lamps to the trade. This is an 80 c.p. lamp with a total wattage of 100, or 1¼ watts per candle-power. The lamp is not yet offered for sale.

It is very often necessary to start or stop the operation of lamps, motors, or other electrical appliances at times and places where personal attention would be both inconvenient and expensive. The demand for mechanical means to accomplish this service is continually growing, especially in the lighting field, and the Automatic Time Switch for opening and closing electrical circuits is therefore a subject of considerable economic interest to the cen-

G. E. AUTOMATIC TIME SWITCH WITH DOOR OPEN.

tral station manager. The individual customer of electric current uses the Automatic Time Switch to get the greatest effect from his display lighting with the least annoyance and current consumption. Numerous important uses are developed for the devices where those installed are found to be reliable and *durable*.

It is of the utmost importance in selecting an automatic time switch that one be obtained in which the chance of failure is reduced to a [illegible] The operation of the time switch is [illegible] ject to the scrutiny of the [illegible] public, and long maintained [illegible] tial feature. Among the [illegible]

York. The Chase-Shawmut Company ask for Mr. Pennefather a continuance of the liberal patronage heretofore bestowed upon them.

With more space and machinery the Chase-Shawmut Company are better equipped than ever for giving prompt attention to the orders they may receive.

The Chase-Shawmut Company have just received their new Bulletin No. 36, which they are distributing to the trade. This is a twelve-page pamphlet in which is listed all of their lines of fuses and fuse fittings.

The new N. E. C. single pole barrier porcelain bases are now on the market. This line includes both the 30 and 60 amp. classes for 250 and 600 volts.

The double and three pole 100 amp. N. E. C. porcelains are listed here as well.

In the last page is listed the Shawmut Extended Terminal Fuse, which they have recently put on the market. These fuses fit any Type A Block of Noark, D. & W. or Shawmut manufacture, and are becoming very popular with the jobber.

Atlas Engine Works, of Indianapolis, Ind [illegible] just issued their general Bulletin No. 13 [illegible] lustrations and specifications of their [illegible] styles and sizes of engines and boilers for [illegible] of work. The bulletin contains one or m[illegible] tions of every object, with the most [illegible] concerning the particular class of eng[illegible] illustrated. The Atlas Engine Wor[illegible] gest exclusive builders of steam [illegible] ers in the world.

The Babcock & Wilcox C[illegible] from the Stirling Consolidat[illegible] as of December 31, 1906, its [illegible] interests, including all accou[illegible] and has assumed its oblig[illegible] its orders and contracts [illegible] ances for installation an[illegible]

The plants thus purch[illegible] future by the Babcock [illegible] the name and style [illegible] Company (Stirling [illegible] operated under the di[illegible] of the same gentleme[illegible] ling Consolidated B[illegible] who have been co[illegible] solidated Boiler [illegible] will be associa[illegible] Company in si[illegible]

The Babcoc[illegible] partment), w[illegible] & Taylor an[illegible] tenances h[illegible] Consolida[illegible]

[illegible] est adapted for reliable opera[illegible] are built up [illegible] copper [illegible] provided [illegible] contact surface [illegible] but always [illegible] The terminal [illegible] a porcelain [illegible] While [illegible] nor [illegible] per cent. overload.

[illegible] switch was designed with the idea of [illegible] parts as possible, and [illegible] both [illegible] the circuit breaker are operated by a [illegible] spring. It is enclosed in a heavy barrel [illegible] with its gearing for actuating the circuit [illegible], is mounted between cast-iron plates. [illegible] teeth in the switch train are of ample [illegible] strength to withstand the sudden shock to [illegible] they are necessarily subjected during their [illegible] operation.

Standard clock movements do not possess the necessary strength and reliability under severe conditions to successfully operate in this class of apparatus. A clock of small size and very rugged construction was especially designed for the General Electric time switch. The escapement is of the lever type which has proved capable of withstanding the greatest amount of vibration and hard usage. Extra long bushings and pivots are provided, thus guarding against wear and improving the easy running qualities of the clock.

The clock movement rotates a dial which makes one revolution every twenty-four hours. The dial is graduated in quarter hours, and is numbered with two sets of figures, from one to twelve. One-half the dial is blackened to distinguish night from day; a feature which is very convenient when adjusting the operating cams at the edge of the dial. There are two of these cams. They revolve with the dial, and act upon a set of levers which in turn release the train of gears controlling the circuit breaker. It is impossible for the release to occur except at the instant when a cam passes a lever, and thus definite control of the circuit breaker is obtained. The operation of the circuit breaker mechanism then automatically resets the levers to their original position, where they check further immediate action.

…LY TO THE INTERESTS OF ELECTRIC LIGHTING AND POWER STA…

NEW YORK, MARCH, 1907 ISSUED M…

Central Station Light, Heat and Power Principles

BY NEWTON HARRISON

… on *Transmission.*—Whether direct or … current is employed, the efficiency or … of power returned from the total sent … line demands attention. The problem of …itting 100 h.p. a given distance requires con…ation based upon the conditions as follows: …drop in the line, the power wasted in the line, … pressure, the cost of copper employed, the rela…n between the cost of copper and the power wasted in transmission, and other data of import…nce. To examine a specific case, according to the general ideas prevailing, take 100 h.p. transmitted a distance of one mile with 10 per cent. drop. If the engine or turbine shows 100 i.h.p., then the dynamo transforms 95 per cent. into electrical energy. When 95 per cent. or 95 h.p. enters the line, only 90 per cent. is delivered at the other end. The power delivered at the distant end of the line is 95 h.p. minus 9.5 h.p., leaving a balance of 85.5 h.p.

The process is not complete as yet, although the power is now at hand ready for use. It is necessary to transform it again into mechanical energy. This transformation roughly involves a loss … 5 to 10 per cent. This being the case the bal… will be the difference between 85.5 — 8.55 … at 10 per cent. loss in the motor, or the d… between 85.5 — 4.275 = 81.225 per cent. … cent. loss in the motor.

The efficiency of transmission in any ca… 100 h.p. at one end, and the loss througho… namo, line and motor of 10 per cent. ap… spectively, will be about 77 per cent. The … is thus reduced to 77 h.p. from the beginni… end of the system. The question arising in… tion with this subject is that of the cost … mission. The actual transmission can be… accomplished if the cost is not prohibitiv… instances where this threatens to be the cas… means must be employed to raise the effici… reduce the cost of installation.

A Higher Efficiency and a Lower Cost… power is subtracted from the total amount … the line it disappears in the form of heat. It… the C^2R loss, and is due to the degradation… trical energy through resistance. The loss …

to satisfactory operation, and which must be considered when designing an automatic switch, are the following:

First. The apparatus must contain the fewest possible number of parts compatible with smooth operation.

Second. The opening of the circuit must not burn the contacts.

Third. The opening or closing of the circuit must be independent of external temperature conditions.

Fourth. The case must be strong enough to prevent malicious tampering or accidental injury.

Fifth. The clockwork should be stronger than is required in ordinary timepieces, and all electrical and mechanical connections should be designed for rough usage and little wear.

The General Electric Automatic Time Switch—Type T has been designed to meet the requirements of the most exacting conditions. The apparatus is suitable for alternating or direct current circuits without change. The automatic closing and opening of the circuit is done by an approved form of circuit breaker and controlled by single clock movement. The General Electric Company's design eliminates troubles frequently experienced with time switches, such as failure to operate on account of deterioration, inexactness in time through cheap and inaccurate clockwork, inability to work properly under variations in temperature or other external conditions, etc.

The case of the Automatic Time Switch is a single iron casting with two compartments entirely separate from each other. This arrangement prevents dust or moisture from entering the clock compartment, and by mounting the pivots on the partition, a very rigid method of supporting the mechanism is obtained.

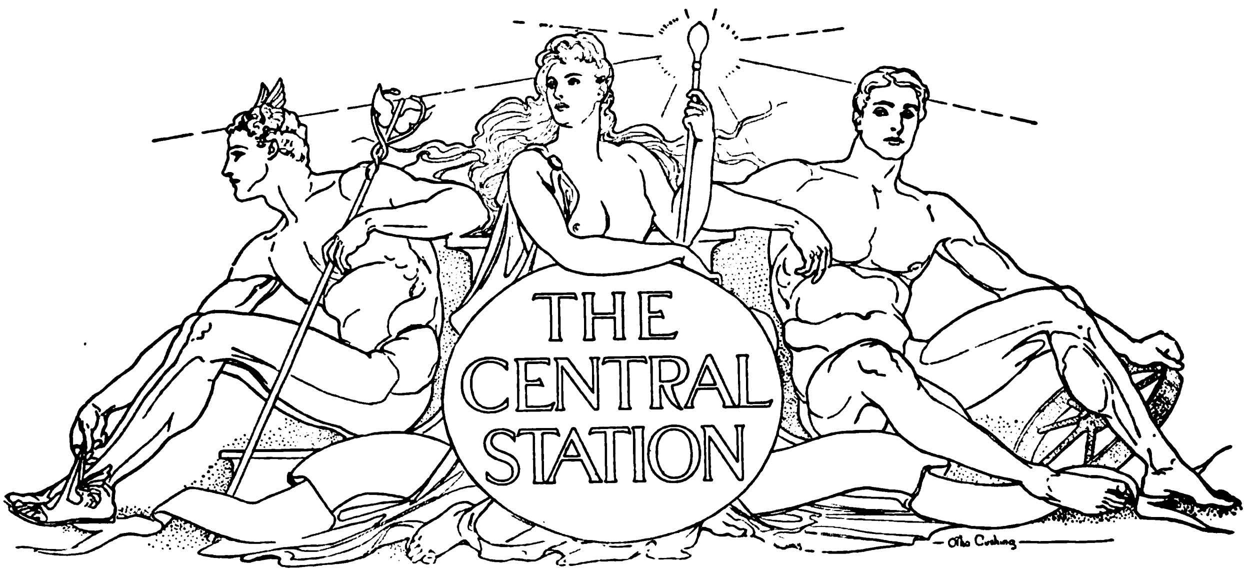
The back of the case is removable, permitting easy access to the circuit breaker. Around the edge of the door is placed a rubber gasket which is compressed by the latch when the knob is turned. The door is provided with lock and key to prevent tampering when installed in exposed positions. It may also be sealed if desired.

The laminated brush type of circuit breaker is selected as the form best adapted for reliable operation. The brushes are built up of spring-leaf copper, and the outside leaf is provided with an arc burning tip. The main contact surface, therefore, cannot become roughened, but always presents smooth rubbing surface. The terminal blocks are substantially mounted on a porcelain terminal board. While neither cumbersome nor complicated, the contacts provide for 100 per cent. overload.

The time switch was designed with the idea of using as few parts as possible, and to this end both the clock and the circuit breaker are operated by a single mainspring. It is enclosed in a heavy barrel, and, together with its gearing for actuating the circuit breaker, is mounted between cast-iron plates. The gear teeth in the switch train are of ample size and strength to withstand the sudden shock to which they are necessarily subjected during their momentary operation.

Standard clock movements do not possess the necessary strength and reliability under severe conditions to successfully operate in this class of apparatus. A clock of small size and very rugged construction was especially designed for the General Electric time switch. The escapement is of the lever type which has proved capable of withstanding the greatest amount of vibration and hard usage. Extra long bushings and pivots are provided, thus guarding against wear and improving the easy running qualities of the clock.

The clock movement rotates a dial which makes one revolution every twenty-four hours. The dial is graduated in quarter hours, and is numbered with two sets of figures, from one to twelve. One-half the dial is blackened to distinguish night from day; a feature which is very convenient when adjusting the operating cams at the edge of the dial. There are two of these cams. They revolve with the dial, and act upon a set of levers which in turn release the train of gears controlling the circuit breaker. It is impossible for the release to occur except at the instant when a cam passes a lever, and thus definite control of the circuit breaker is obtained. The operation of the circuit breaker mechanism then automatically resets the levers to their original position, where they check further immediate action.



DEVOTED EXCLUSIVELY TO THE INTERESTS OF ELECTRIC LIGHTING AND POWER STATIONS.

VOL. 6, No. 9. NEW YORK, MARCH, 1907 ISSUED MONTHLY

Central Station Light, Heat and Power Principles

BY NEWTON HARRISON

Efficiency in Transmission.—Whether direct or alternating current is employed, the efficiency or percentage of power returned from the total sent into the line demands attention. The problem of transmitting 100 h.p. a given distance requires consideration based upon the conditions as follows: The drop in the line, the power wasted in the line, the pressure, the cost of copper employed, the relation between the cost of copper and the power wasted in transmission, and other data of importance. To examine a specific case, according to the general ideas prevailing, take 100 h.p. transmitted a distance of one mile with 10 per cent. drop. If the engine or turbine shows 100 i.h.p., then the dynamo transforms 95 per cent. into electrical energy. When 95 per cent. or 95 h.p. enters the line, only 90 per cent. is delivered at the other end. The power delivered at the distant end of the line is 95 h.p. minus 9.5 h.p., leaving a balance of 85.5 h.p.

The process is not complete as yet, although the power is now at hand ready for use. It is necessary to transform it again into mechanical energy. This transformation roughly involves a loss of from 5 to 10 per cent. This being the case the balance left will be the difference between $85.5 - 8.55 = 76.95$ at 10 per cent. loss in the motor, or the difference between $85.5 - 4.275 = 81.225$ per cent. at 5 per cent. loss in the motor.

The efficiency of transmission in any case, with 100 h.p. at one end, and the loss throughout in dynamo, line and motor of 10 per cent. apiece, respectively, will be about 77 per cent. The 100 h.p. is thus reduced to 77 h.p. from the beginning to the end of the system. The question arising in connection with this subject is that of the cost of transmission. The actual transmission can be readily accomplished if the cost is not prohibitive, but in instances where this threatens to be the case, certain means must be employed to raise the efficiency and reduce the cost of installation.

A Higher Efficiency and a Lower Cost.—When power is subtracted from the total amount sent into the line it disappears in the form of heat. It is called the C^2R loss, and is due to the degradation of electrical energy through resistance. The loss is serious

in character and increases rapidly with any increase in current in the line. The relationship of power loss in transmission to the number of amperes in the line is shown by the following figures:

Amperes.	Volts.	Distance in Miles.	Resistance in Ohms.	Total Drop	Loss in Heat Watts.
10	1000	1	10	100	1000
9	1111	1	11	99	891
8	1250	1	12	96	768
7	1428	1	13	91	637
6	1667	1	14	84	504
5	2000	1	15	75	375
4	2500	1	16	64	256
3	3333	1	17	51	153
2	5000	1	18	36	72
1	10000	1	19	19	19

The above figures illustrate the influence of a diminishing current and an increasing resistance upon the losses experienced in the line. The amperes are shown to diminish systematically, to volts to increase, but the total amount of power is kept constant. The loss of watts due to the current and resistance is shown to diminish with increasing voltage and even with increasing resistance.

The greater losses are those involved in the use of a heavy current. One of the axioms, therefore, of power transmission is that of keeping the current at a minimum. The conclusion to be drawn from this proposition is that the only way in which the watts wasted can be limited is by the employment of high pressure in transmitting the power. In the first line of figures given, the total drop with 10 ohms and 10 amperes is 100 volts. It is readily seen that 100 volts drop with 10 amperes in the line would mean the loss of 1,000 volts. The loss in volts and the loss in power are equally indicators of the percentage of power dissipated. For instance, a loss of 100 volts out of 1,000 shows a waste of 10 per cent. Similarly a resistance of 10 ohms causing this 100 volt drop causes a waste of 1,000 watts of power, or 10 per cent. of 10,000 volts, the total power to be transmitted.

Effects of Increased Pressure.—The transmission of power over a line in which the following conditions occur will illustrate another feature in connection with this subject. Suppose a power line a mile in length is erected whose total resistance is 2 ohms. If 10 kilowatts of power are to be transmitted at a pressure which is to be raised to obtain the most economic results, then the following considerations must be observed: The effect of an increasing pressure—the total amount of power remaining the same, and the resistance of the line not varying—will be that of greatly improving the operation of the system. This improvement will manifest itself in a reduced loss in transmission, collectively represented by less drop, and therefore less loss in heat. In the case specified, 10 kilowatts of power represent 10,000 watts which, at a pressure of 100 volts, will call for a current of 100 amperes. In a line whose resistance is 1 ohm, the total energy would be wasted in heat and the total pressure in drop. This is readily shown in squaring the current and multiplying it by the resistance, or 100 × 100 × 1 = 10,000 watts dissipated in heat, or 100 × 1 = 100 volts lost in transmission. This entire degradation of the sum total of power into heat illustrates a case in which the efficacy is zero. There is no return at the other end, and the line, therefore, with respect to the conditions under which the power is being transmitted, is totally unsuited to the particular pressure employed. To carry out the idea further, let the pressure be raised 10 times its value, which is 1,000 volts. Let the results of this change be carefully examined with respect to the applicability of the line as it is at present, that is, 1 ohm resistance. Under these circumstances, 10,000 watts at 1,000 volts would mean a current of 10 amperes. At 1 ohm resistance, as stated in the line, the drop would be 10 × 1 = 10 volts. The loss in heat would be 10 × 10 × 1 = 100 watts. The influence of pressure therefore is manifested as follows: The increase of pressure to 10 times its original value, namely, from 100 to 1,000 volts, has had the effect of reducing the heat loss from 10,000 volts, representing the waste of all the power, to 100 watts, or only 1 per cent. of the power. Raising the pressure to 10 times its value has reduced the loss down to 1/100 of its value. This relationship will be clearly shown in other ways in connection with power transmission problems. The fundamental fact is thus presented, that if the resistance of a line remain constant and the power constant, but the pressure increases, the loss becomes reduced inversely as the square of the pressure. According to this statement, doubling or tripling the pressure, the total power and line resistance remaining the same, means a reduction of the heat loss

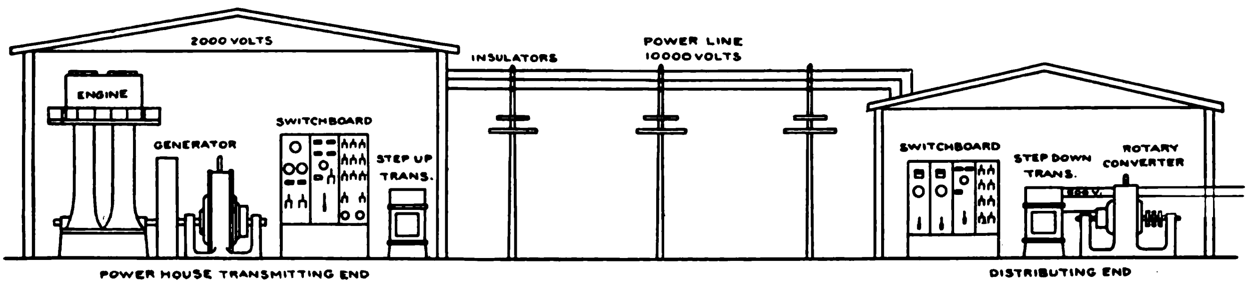
from ¼ or 1/9 of its value with the original pressure. The following table illustrates the effect of a higher pressure in transmission:

Table Showing the Effect of a Higher Pressure in Transmission.

Amperes.	Total Watts.	Volts.	Resistance of Line in Ohms.	Distance in Feet.	Drop.	C^2R in Watts.
1000	100000	100	10	50000	10000	Complete loss
500	100000	200	10	50000	5000	Complete loss
250	100000	400	10	50000	2500	Complete loss
200	100000	500	10	50000	2000	Complete loss
100	100000	1000	10	50000	1000	100000
50	100000	2000	10	50000	500	25000
40	100000	2500	10	50000	400	16000
25	100000	4000	10	50000	250	6250
20	100000	5000	10	50000	200	4000
10	100000	10000	10	50000	100	1000
5	100000	20000	10	50000	50	2500
2.5	100000	40000	10	50000	25	62.5
1.0	100000	100000	10	50000	10	10.0

volts, the loss becomes 1/100, or only 1,000 watts. The immediate practical value of high pressures in power transmission is thus exemplified in showing as well the small loss in volts. Power transmission under these circumstances becomes a matter of high pressure to be successfully conducted, and, as naturally follows, a matter of high grade insulation. The efficiency with 1,000 volts is zero in the foregoing table; with 2,000 volts it becomes 75 per cent.; with 4,000 volts it becomes 93¾ per cent., etc.

These ideal figures merely serve to show the trend of intelligent practise. When everything is considered, the efficiency falls very much lower, though the chance of sustaining it lies in the pressure and line resistance. The decision regarding the line resistance is really a conclusion regarding its cost as copper. It does not take into consideration the cost of high grade insulators. It leaves out the question of poles and the cost of installing them. In fact, the principal problems are those which,



The efficiencies will rapidly rise, according to these figures, as soon as a point is reached where the better effects of an increased pressure can make itself felt. The dead loss experienced in a 10-ohm line is felt all along until 1,000 volts have been passed. At this point 100 amperes are employed to give the full quota of power. The loss is complete, however, in the line. One thousand volts disappear as pressure and 100,000 watts as power. With an increase in pressure, however, the conditions change for the better. The pressure is doubled, which would mean, according to the principles outlined, that the loss becomes one quarter. Following the 2,000 volts pressure along to the loss in watts, it is seen that the dissipation of energy has become only 25,000 watts. Passing from the 1,000 volts with 100,000 watts loss, to four times the pressure, or 4,000 volts, the loss is shown to be 1/16, or only 6,250 watts. Following the 4,000 volts up to 10,000

when solved satisfactorily in an electrical sense, call for financial consideration. The problem of the line becomes a fourfold one with regard to the engineering difficulties involved.

These might be included under headings as follows:

$$\text{Line}\begin{cases}\text{Resistance}\\ \text{Pressure}\\ \text{Insulation}\\ \text{Installation}\end{cases}$$

The resistance of the line largely determines the best pressure at which economical operation can be expected, or vice versa. The pressure determines the quality of the insulation, and this and the other two the character and cost of the line as an installation.

Generating the Power.—The fact that a high

pressure is necessary in developing useful power for transmission; that it must be transformed up or down, as case may be, and that a commutator is absolutely out of the question for pressures beyond a certain point, leads inevitably to the conclusion that the only solution to this problem to be found in the application of an alternating current. Here again a difficulty arises of a most important character. The simple alternating current, though readily generated and transformed, is hardly suited to the purposes ultimately held in view, namely, the transformation of electrical into mechanical energy. A simple alternating current motor, whose use in the conversion of alternating into direct or direct into alternating currents is so necessary, will not operate in its generally accepted form. Recourse is had to the two and three-phase alternating current for such purposes. These currents are serviceable in the use of self-starting economical motors for power transmission purposes. The power generated therefore must be in such a form that the accomplishment of the purpose in view can be successfully carried out.

Modern power transmission plants consist of a complete equipment, representing two and three-phase alternators, Figure 1, step up transformers, oil switches, and either water power or steam as the source of energy. The receiving or distributing end of the system holds step down transformers and rotary converters. If the current is to be distributed simply as an alternating current useful for power purposes, no rotary is necessary. The essentials of a power house and those of the distant end of the plant, are so related that the efficiency is preserved in every reasonable manner possible. Yet, in spite of such precautions, the use of an alternating current, though absolutely necessary in power transmission, presents difficulties.

Use of Transformers.—The alternating current readily lends itself to the ready transformation of pressure up and down. The transformers stepping up the pressure, or stepping it down, are called "step up" and "step down" transformers. They serve the function in the power house of raising the pressure to the proper point for transmission. All of the energy enters them at one end of the circuit. Before it is handled for distribution it is sent through another set and "stepped down" to a safe pressure. The entire process, one very vital to the efficiency, is carried on in the following machines: In the engine or water wheel, in the generator, in the transformer, in the line, in the rotary converter, and then in the city distributing lines. This may be represented in the following manner:

Power House		Distributing Station
Engine		Transformers
Dynamo	Line	(Step down)
Switchboard		Rotary Converters
Transformers		Street Lines
(Step up)		

If some estimate is made of the net results of the process from the standpoint of efficiency, based upon a general efficiency of 90 per cent, per machine throughout the plant, the figures would show a lower efficiency than would be anticipated at first glance. Taking 1,000 horse-power in the engine, the dynamo would yield 900 horse power, the switchboard and transformers 10 per cent. less, or 810 horse-power; the line 10 per cent. less, or 729 horse power; the transformers 10 per cent. less, or 656 horse-power; and the rotary converters and street lines 10 per cent. less, or 590.4 horse-power.

Criticism could of course be justly made of this uniformly sweeping rating, but it serves the purpose of showing how a slight gain in the dynamo transformers or line of distributing station will accrue to the benefit of the total efficiency. The erectors of our large plants claim higher percentages of efficiency than this, but a 30 or 40 per cent. loss is not to be considered very large under certain conditions in practise.

Underwriters' National Electric Association.

The annual meeting of the Electrical Committee of the Underwriters' National Electric Association will be held at the rooms of the New York Board of Fire Underwriters, 32 Nassau street, New York City, on March 27 and 28, for the purpose of making changes and additions to the National Electric Code. As is well known, it has always been the endeavor of the Electrical Committee to make only such changes in the Code as are made necessary by progress in the art, or such as have been shown by some field experience to be necessary to safeguard against hazard, since changes in the code, even if necessary, cause more or less confusion and trouble.

Prepared for THE CENTRAL STATION by Colin P. Campbell, Attorney.

Negligence to Workmen Near an Uncovered Wire—Injury by Current—Contributory Negligence in Working Near Feed Wire.

The opinion of the court which states the facts and conclusions of law thereon satisfactory, is given as a whole. This case, while it involves a railroad company, at the same time involves the questions of negligence and contributory negligence as to and by persons working near highly charged electrical conductors. The opinion of the court is as follows: The plaintiff was in the employ of the defendant as an ironworker on its elevated structure, and, on the day of the accident from which he suffered injuries, was one of a gang engaged in drilling holes directly under the top girder of the track. A foreman had previously marked the places at which the holes were to be drilled. The plaintiff had been engaged in similar work in the immediate neighborhood for several days, and for about nine months had been engaged in doing similar work on various parts of defendant's structure, during which time the road had been operated electrically through what is known as the "Third-Rail System." At the point at which the plaintiff was working at the time of the accident, certain wires, four or six in number, pass under the structure, attached thereto rather loosely, so that they are movable, and served to carry the electrical current to the third rail. In drilling the holes, plaintiff and his co-workers used a series of contrivances or tools known as a "knee," a ratchet, and a clamp. The knee, consisting of a piece of double-angled iron weighing about 29 pounds, is attached to the ironwork in which the hole is to be drilled by the clamp, weighing about 25 pounds, and between the iron and the knee is inserted the ratchet, weighing about 14 pounds, into which the drill is fixed. The gang was engaged in setting up the ratchet upon an upright girder preparatory to drilling a hole therein, plaintiff holding up the knee, which was being clamped to the structure. Plaintiff and his companions observed the feed wires in close proximity to their tools, but paid no particular attention to them, and took no precaution against touching them with their tools while engaged in clamping the knee and the ratchet. Before this work was completed there was an explosion and blinding flash, whereby plaintiff was burned and seriously injured. There can be no doubt this explosion was caused by contact between one of the iron tools and one of the feed wires, resulting from some break or defect in the insulation of the wires.

The evidence fairly establishes that there must have been a defect in the insulating material either existing prior to the occurrence or caused at the moment thereof by abrasion from the heavy iron tools or implements then used by the plaintiff and his gang. The plaintiff had a verdict upon the trial, in the City Court, which was reversed upon appeal to the Appellate Term of this court. We would be quite satisfied with the disposition of the case by that learned court were it not for the fact that no attention seems to have been paid to the duty laid upon the master when he sets an employee at work in a place hazardous by reason of hidden dangers known to the master and unknown to the employee. It has always been the law that an employee assumes the obvious risks of his employment, and the employer's liability act, chapter 600 of the Laws of 1902 (Laws of 1902, p. 1748), has modified the rule only in so far as to require a submission of the question to the jury as one of fact whether the employee understood and assumed the risk of injury.

But it is the obvious risk that is assumed. Latent,

hidden dangers known to the employer and unknown to the employee of which no information or warning or instruction has been given, are not assumed. The duty of the master is to furnish a safe place in which to perform the work. This master's duty cannot be delegated. There are kinds of work which are inherently unsafe, and can only be prosecuted with the utmost care and caution. When danger lurks in apparently harmless instrumentalities, the duty of instruction and warning is imperative. A stick of dynamite carries no terrors to the ignorant. A wire can transmit by an innocuous current the messages of commerce or of social life through the inductive agency of the telegraph or telephone instrument, or it may carry an electric current for light or motive power of such force and intensity as, if interfered with, to cause instant death. To inform and instruct under such circumstances becomes part of the duty of the master which cannot be delegated. This obligation the defendant seems to admit and to have realized upon the trial. Its superintendent of structure, Riley, testified, "It was my duty to instruct those men as to the dangers attending their work, and caution them to be careful of the third rails and wires. I was directed to do so by my superior officer, the road engineer, Mr. Lockwood. He directed me to instruct my foremen, and my directions to the foremen were to warn their men. It is a fact that I did instruct the foremen under my direction. I instructed Kehoe and Fitzgerald. I gave instructions to them to warn their men of the dangers attending contact with the third rail or wire."

If this testimony stood for its full value and uncontradicted, it would appear that the defendant performed its duty. But Fitzgerald, the foreman of riveters, under whose orders the plaintiff was, testified: "I did have instructions from Mr. Riley, the general supervisor, to warn my men as to all dangers connected with electricity on the road, of all dangers, but there was no reference made to the wire. I did not give them any caution as to letting them come in contact with the electric wires. I referred more or less to the third rail. I did not know just what danger there was to those wires. These wires that ran from one side of the structure to the other were connected with the third rail. I did not instruct them about any danger connected with the electric wire particularly, because I knew nothing about it. I did not get any instructions myself to that effect."

The plaintiff testified: "I do not know what the purposes of those wires were—what they were used for. I don't know what they were used for, not when I went there, and I don't know yet; I had not any experience. I was hired to use the ratchet; that is all I was doing while I was on the road. During all the year I was on the road I never heard what any of these wires were for; I had seen them, but never passed any remark about them; did not know what they were."

It appearing that the plaintiff had to work with heavy iron tools in close proximity—two inches—to these wires, and that they carried a heavy current of electricity, it seems to me that if we assume that the wires were of the best quality as to insulation, that they had been properly inspected by a competent inspector, within a few days of the accident, that no flaw in the insulating covering had been discovered, and even assume that in the process of the adjusting this knee and brace the plaintiff himself had caused a break in the covering of the wire, and that thereby a short circuit was established, it yet remained a question for the jury whether the defendant had been negligent in failing to properly warn and instruct the plaintiff. If so, and the accident resulted therefrom, then the fact that plaintiff may have caused the short circuit by allowing the tool to come in contact with the wire would not necessarily defeat him. Conduct which, with knowledge, would constitute contributory negligence, without knowledge or warning or instruction might not. Whether or not an act is negligent must always depend upon the attendant circumstances.

Carey v. Manhattan Ry. Co., 101 N. Y. Sup. 631.

Validity of Exclusive Grants of Franchises. Continued

By mistake the matter of policing the lines and the matter of exclusive grants was transposed in sending the manuscript for the last article. Consequently the matter here treated should have appeared in the last article. We therefore continue the matter of Exclusive Grants here and leave the continuation of the matter of "policing the lines" to another article.

It is necessary in considering this matter of Exclusive Franchises to bear in mind certain general propositions which have already been enumerated but which can be stated again without detracting from the clearness of our statement.

First, the Cases incline against the exclusive

franchises and require where these grants are given effect that they be very clearly made out; and they will not under any circumstances be implied. In a majority of the States, however, the exclusive franchises are held not to prevent the grant of franchises to competing companies, but are generally held, although from this there is some dissent, to prevent the public introducing plants of their own or taking current from the competing companies.

The principles involved in our subject are not different from those involved in other cases in Connecticut, for example, an exclusive right to lay gas pipes in the streets of the city in so far as it restricted the free manufacture and sale of gas was held void as creating a monopoly. Norwich Gas Light Co. v. Norwich City Gas Co., 25 Conn. 10. On the other hand, in Iowa, the grant of an exclusive privilege to supply the city of Davenport with water was held valid. Grant v. City of Davenport, 36 Ia. 396. These cases, however, are distinguishable because, in the first case, the point involved concerned the grant of an exclusive right to supply the citizens generally with gas, whereas the second same involved the supply of the city alone, and as the city may contract with whomsoever it pleases, after it has made a contract with one corporation for a definite period, may not under the provisions of the Federal Constitution break that contract by taking water from another company. There is nothing in the latter case, however, which would prevent the citizens from contracting for water for private purposes with another company, or would exclude the mains and pipes of another company from the streets. The act in the Iowa case consequently did not produce a monopoly and consequently was not objectionable upon the ground urged against the Connecticut law. Upon another theory a grant of an exclusive privilege of supplying the city and its inhabitants with gas was held valid in Louisiana. Crescent City Gas Light Co. v. New Orleans Gas Light Co., 27 La. Am. 138.

In that case the court squarely raised the question as to the power of the Legislature of Louisiana to grant to a corporation the sole and exclusive right to manufacture and sell illuminating gas in the city of New Orleans. Proceeding, the Court says, "Now what clause of this Constitution had been violated in the case at bar? Is the bill of rights: all persons shall enjoy the same civil, political, and public rights and privileges, and be subject to the same pains and penalties" in any manner invaded? Is "life, liberty or the pursuit of happiness" of any person in the city of New Orleans assailed by the statute, granting the sole and exclusive privilege to plaintiff to operate gas works in New Orleans for fifty years? The right to operate gas works and illuminate a city, is not an ancient or usual occupation of citizens generally. No one has the right to dig up the streets and houses of the city of New Orleans, without special authority from the Sovereign. It is a franchise belonging to the State, and the State, exercising its police power, could carry on the business itself, or select one or several agents to do so." The Legislature therefore had the power under the reasoning of this opinion to confer this special authority upon the gas company in this case.

In Massachusetts a unique situation was presented in the case of Attorney General Ex. Rel. Board of Gas & Electric Light Commissioners v. Walworth Light and Power Co., 157 Mass. 86. It appeared herein that the statute under which defendant was organized provided that "in any city or town in which a company is engaged in or organized for the purpose of the manufacture and sale of electric light, no other company shall lay or erect wires under the streets, lanes, and highways of such city or town, for the purpose of carrying on its business, without the consent of the Mayor or Aldermen of such city, or selectmen of a town, after a public hearing and notice to all parties interested." Defendant was using two wires of another company which had never gained permission to put in the wires, but had put them in a tunnel which it had been suffered to lay for carrying a shaft and strain through. Defendant itself has never fained any permission to use the streets for wires. Wires were erected by it across the street to supply customers. Two other companies were engaged in the same business in the city pursuant to authority granted. The question was raised whether under the statute the wire in question could be excluded from the street when the customers of the company paid for it The Court said, and its opening sentences are applicable to the general problem before us, "The legislature may think that a business like that of transmitting electricity through the streets of a city has got to be transacted by a regulated monopoly, and that a free competition between as many companies and persons as may be minded to put up wires in the streets, and to try their luck is impracticable."

The Central Station

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Central Station Development,

Last century electric lighting began to establish itself in the home and store as a fixed institution. To-day the total number of lamps in use fed by the electric current runs into the millions. A brief résumé of the situation will be of interest to the average reader in this respect. In 1881 there were 8 stations in service; in 1886 there were 100 stations; in 1889 there were 208, and in 1892 the number was 247. About this time, according to the report published, a condition of business depression existed, which held up further development until 1895, when the number of stations rose to 239. From that time on, progress in this comparatively new field of industry went on by leaps and bounds. In 1898 the number of stations was 277, in 1901 they amounted to 250, in 1902 they reached nearly 300. To quote from the report prepared by Mr. W. M. Stewart, chief statistician for manufactures of the Bureau of the Census, "In 1902 there was in the United States 3,620 central electric stations, with a cost of construction and equipment of $504,740,352. Employed were 6,996 salaried officials and clerks, with salaries amounting to $5,663,-580; and 23,300 wage earners, with wages amounting to $14,983,112. The gross income was $85,700.-605, comprising $84,186,605 from sale of current, and $1,514,000 from other sources. Total expenses were $68,081,375. The total output of stations for the year in kilowatt hours was 2,507,051,115. The number of arc lamps was 385,698, and of incandescent lamps 18,194,044.

This was five years ago, all but a few months; since that time, the estimates of any increase would reach figures far overstepping these, if it was only the result of a natural increase in the stations already existing, without adding new ones to the list. At present the estimate of central stations would show figures lying between 4,000 and 5,000. The number of lamps, and the kilowatt hours, are by far too speculative a figure to arrive at without a thorough canvassing. The increase is tremendously rapid, and the demand for power to date unprecedented.

Fatal Accidents.

Fatal accidents will occur in power houses in spite of everything that is said or done. Fortunately such fatalities are not of frequent occurrence in this country, in spite of the large number of power houses scattered throughout the length and breadth of the land. In England the subject of death by electric shock is receiving considerable attention, due to two fatal cases which recently occurred. One of the victims was a trained electrical engineer, who knew the dangers of the station and was pointing them out to a laborer whose duty called for a series of alterations. His hand came in contact with a live part of the switchgear while his attention was taken up with conversation relating to the work. The other victim was a workman who, it seems, was admitted to a high tension sub-station to perform certain duties without ap-

parently realizing the serious nature of his surroundings, a fact which, after the accident, brought upon the company owning the station censure from the coroner and his jury. Adequate precautions are necessary to protect those who are not acquainted with the dangers attending high tension working, but we know that technical men who do know the dangers too frequently disregard their existence and omit to use the special precautions provided. There is at least the text of a long lecture to be found in these remarks.

The curious state of mind or absent-mindedness, which causes death in the case of an electrical expert, belongs perhaps to the same category as the carelessness of the bacteriologist or physician face to face with the seeds of death. At least one fact is of importance, in a review of the possibilities of a fatality with electric wires, and that is the absolute refusal to ever go amongst them except with adequate protection. One customary form of this is the rubber gloves; another the rubber shoes, and still another the use of one hand only in handling wires, unless the circuit has been opened.

But as long as human beings are fallible, it is going to be accepted as an axiom, that they will be shocked and killed by electricity which exceeds a certain safe pressure, even with the best of precautions.

Copper Gain in Transmission.

The problem now confronting the builders of our transmission plants, is that of choosing the highest economical pressure consistent with engineering limitations, as now imposed. Bit by bit the pressure has crept up in experimental and commercial transmission plants, until from hundreds of volts it became thousands, from the thousands of volts it became tens of thousands. The copper question has been the determining influence throughout, although it is sometimes misconstrued as the economic from the power standpoint. But it is easy to understand that all economies as far as copper is concerned, are only worth considering in so far as they affect the important expenditures and savings. By this is meant that the development of a principle is only a necessity when its neglect means no further progress and no further gain. Therefore the idea of raising the pressure to transmit a certain amount of power, meant, not only greater economy in transmission, but greater saving in what would otherwise have to be spent for copper to transmit that power. Doubling the pressure means one-half the amperage in a circuit to get the same power. On this basis it is easy to see how the pressure must go on rising and rising until the very limits of insulation are reached.

The high pressure, and therefore the copper saving problem, is one which will adjust itself in the course of time by propositions being crystalized that reach the limits of transmission as far as the actual power transmitted is concerned. But this adjustment is not likely to be reached until at least 500 miles have been covered. So far no reliable data is at hand but that obtained from shorter reaches of line; yet no doubt is actually felt by either the promoters or the engineers of great schemes of this character, but that the power will be transmitted over even such long runs as 500 miles with great economy and with a marked advantage in copper weight.

Hydro-Electric Stations.

A fact which should never escape the vision of the engineer, is that plants of this type are designed for the purpose of making money. Another fact of equal importance is that such plants are so related, as a rule, to the energy they supply, that a set of conditions are bound to exist, which produce a changing distribution of the load. It thus seems evident from this casual survey of the situation, that the two primary points of importance are: first, the financial objective; and secondly, the engineering fulfillment in view. Analysis of such conditions and such purposes cannot lead to any advantage unless there is at least this to be said: that the conditions are of a character that permits conclusions to be drawn, which if correctly deduced, will open up possibilities of success. To be more explicit, it may be said that the following are indeterminate at first glance, until made determinate by a series of observations which give the amount of rain fall, drainage area, run-off, stream flow, storage, head of water, speed of wheel and generators and hydraulic conditions in general. (See a paper presented at the 205th meeting of the American Institute of Electrical Engineers by David B. Rushmore, on "Design of Hydro-Electric Power Stations.")

The difficulty which presents itself most frequently, after the first problem of plant design has been solved, is that of holding a high general efficiency

throughout the day and night for the equipment as a whole. The variations in load are such, as a rule, that high efficiency is more or less problematic; not by any means because of the design, capacity, character of the machines, or depreciative element being incorrect; but because of the implied difficulty of holding an average high load during the day. This difficulty may be partly overcome by certain contracts for power, which average up to the desired point for a time, yet even in such instances, this may fail after a while, either because of the natural changes to be expected in an industrial center, whose business relations with the rest of the community change; or due to the fact that the load reaches a very high maximum, thus threatening the efficiency from an entirely different standpoint.

The situation as it presents itself with respect to hydro-electric plants, is not so different in general, as that offered by city plants burning coal; with the exception, however, that the meteorological conditions in the latter case are not directly effective except in one respect; that the price of coal may vary sufficiently to cause a slight expense or gain, as the case may be, what must be presented, however, is the fact that varying industrial conditions, varying conditions in climate and weather, and varying conditions in the load, are at least three of the principal elements to contend with in plants of this character. To quote from the last-mentioned author's paper, with respect to the special nature of the apparatus, "The distinguishing feature of hydro-electric installations is the special character of all conditions and apparatus. Generator and transference capacities and voltages are always more or less special, while the systems for transmission and distribution of power are invariably so." The fact of importance in connection with this is that the plant must be able to meet greater or less loads with facility. By this is meant that a great flexibility is necessary in the design, as regards the items enumerated, so as to permit the changes in load to transpire without injury or loss. As the author points out, in connection with this, the selling price of current is a figure dependent upon the degree to which commercial steadiness in having a ready product at hand, is carried out. With questionable supplies of water power, variations enter into the scheme, which will ultimately wreck it, unless they occur beyond the point of greatest average load.

The character of the load is one of the features to which attention should be drawn in any consideration of water-power plants. For this reason, the fact that railway work is to be, or is being done, in addition to general power work and lighting, means a rather complex condition, because of the periods of load that each particular class of work implies. For instance, it is clearly evident that a lighting load will only come on at its full, between the hours of sunset and twelve or one o'clock in the morning. On the other hand, the street-railway load is one which, though undeterminate in some respects, because of blocks, tie-ups and holidays, is one which can be depended upon to be heavy during morning hours, shopping hours, at six o'clock, and certain hours of the night.

This being true, it is clear that a hydro-electric plant with a character of mixed work to do, such as this, will be very hard pressed at times to successfully meet the peak of the load curve without breakdowns or blown fuses. On the other hand, the character of the plant, the durability of it, and the success it meets with in such cases as the above, may be a question as much of locality as of engineering. A high or load head plant is almost what one may call a Western or an Eastern plant. A high head plant means few units, while a low head plant means many. A high head plant means entirely different engineering problems as regards lay-out of plant, and flexibility as thus derived from it. A low head plant means shorter runs, as a rule, with less losses of one kind and more of another, thus definitely establishing the fact that water-power plants at the Pacific and Atlantic slopes differ much in design and functional flexibility. The use of auxiliaries to meet high points of load, the cost of such, the interest on fixed sums of capital, all of these are part of the plan which call for careful examination, and in many instances hesitation, before the actual operation of constructing a hydro-electric plant begins.

The 30th Convention.

The 30th Convention of the National Electric Light Association will be held the first week of June in Washington, D. C.

The New Willard Hotel, the largest and most modern in Washington, will be the headquarters.

MONTHLY REVIEW OF THE TECHNICAL PRESS

On the Prevention of Breakdowns in Central Stations

It is the rule in central stations to make a record of all breakdowns on the daily log-sheet, but unless something further is done, the number of breakdowns will not tend to diminish. Failure of supply or defective supply tends to shake the faith of the general public in electricity, and retards its general adoption. A book should be kept where all breakdowns, however slight, are recorded. A careful study of this book will show how many accidents may be avoided. The writer has kept such a book for several years, and always made a point of getting full information from persons present during the breakdown, if he did not happen to be there himself. The stations he was connected with were fitted with the most up-to-date appliances by the best makers.

Accidents that caused either temporary failure of supply, or defective supply, were classified under four headings:—

I.—Defective machinery or apparatus.
II.—Preventable accidents.
III.—Faulty automatic apparatus.
IV.—Accidents due to carelessness.

The following table shows which class was responsible for the most breakdowns:—

	Number of breakdowns.	Percentage of total.
I.—(*a*) Engines or accessories....	3	6
(*b*) Generators or motors.....	9	18
(*c*) Cables or wiring.........	10	20
II.—(*a*) Engines or accessories....	2	4
(*b*) Generators or motors.....	4	8
(*c*) Cables or wiring.........	6	12
III.—(*a*) Mechanical	2	4
(*b*) Electrical	7	14
IV.—General	7	14

First of all, a brief description of the various breakdowns will be given, and then the lessons the writer has drawn from them by studying the causes.

Dealing with the first class and sub-dividing this, as shown in the table, we find that the three engine breakdowns were unavoidable, and the engine-room staff could not be blamed in any way. Generators and motors used in works were responsible for nine breakdowns. Two of these were due to commutators and four to high-tension coils on alternators giving way. Out of the ten defects on cables, six were due to the insulation of high-tension cables breaking down.

Class II.—Many of these might almost have been classed under the heading "carelessness," but that class has been reserved for inexcusable carelessness.

(*a*) Engines or accessories.—Two stoppages were due to bolts working loose and necessitating the engines being stopped to tighten them up.

(*b*) Generators and motors used in works.—Two cases of shunt connections to adjustable resistances being caught in the gearing to regulating handles, and the shunt circuits being broken. One case of a shunt connection on a machine being almost broken by a man in cleaning the machine, and the shunt circuit failing whilst the generator was on load. There were two cases of cables earthing to tubing through the latter not being fitted with insulating bushes. In the first case this caused a condenser

motor to stop at an unfortunate time, and in the second case the cable led to the only balancer in use at the time, and thus caused serious trouble. Another case was the fuse blowing on the air-pump motor. This was rather a common accident at one of the stations dealt with, and though as a rule it was of little consequence, yet sometimes it seriously affected the supply.

(*c*) Switchboards and cables.—A generator cable fell out of the thimble connecting it to the switchboard and cut the machine off load, thereby throwing a heavy overload on the battery. This was, of course, caused by overheating, either of the switch contacts or through the defective soldering of the cable into its thimble. In many central stations the generator and feeder cables are taken vertically downward from the switchboard with very little support, other than that afforded by the thimbles. Another case was a fire on a high-tension switchboard originated by the breakdown of the insulation of a synchronising cable. The board was fitted with oil-break high-tension switches, and the boxes containing the oil used to leak occasionally, and the fact of the surface of the slate being covered with a film of oil enabled the arcing mentioned to start a fire, necessitating the board being made dead to get the fire under.

A serious case of fire was caused by sparking switch which set fire to the insulation of cables leading to the switchboard and out of sight. Hundreds of pounds' worth of damage was done, the lighting and power supply interrupted for several hours, and the traction supply stopped for a day or so. The last case of this class was caused by a part of the wiring for lighting the station, earthing to the steel tubing. This tubing being of the slip-joint variety, was a poor earth, and some distance from the original fault, the steel tubing arced to the lead covering of a large feeder, burning it through and starting a fault on the feeder. Through the fault on the wiring, the station was thrown into darkness.

Class III.—There were nine breakdowns caused by the faulty acting of automatic appliances. This class is sub-divided into two divisions.

(*a*) Mechanical appliances.—In one case the automatic knock-off gear fitted on an engine, to shut the steam off if by any chance the speed exceeded a certain limit, failed to act. This caused an excessive rise in voltage, a bad thing for consumers using their lamps at the time. The second case was more serious. An overload valve fitted to an engine to admit high-pressure steam direct into the low-pressure cylinder in the event of a sudden heavy overload, apparently worked all right, but after paralleling another generator, this valve could not be got to return to its original position, and the engine was taking steam at an excessive rate. The boiler pressure was considerably reduced before another engine, started up cold, could be got on load to take the place of the faulty engine.

(*b*) Electrical appliances.—Numerous cases of circuit breakers, both of reverse current and overload types, acting when they should not have acted, or failing to act when they ought to have done so. In two cases generator armatures were seriously damaged by their circuit-breakers remaining in during a fault.

Class IV.—Accidents caused by carelessness of staff.—A 1,000-h.p. set on load was pulled up and had to be taken off the bus-bars at once, owing to the bearings not having been inspected several times during the shift. The engine was fitted with forced lubrication, and one of the supply pipes had become obstructed, causing the overheating of the unlubricated part.

Three cases were due to the carelessness or ignorance of switchboard attendants. The first was due to the reckless synchronising of two alternators. In the second case a wrong switch was put in by mistake, switching a standing machine on to the bus-bars instead of a machine that had just been run up. The third mistake was a little excusable. An alternator was being run up on some high-tension feeders that were not alive at the time. The exciter refused to generate, and leaving all switches in the attendant went to the exciter to investigate. It suddenly started generating, and caused an excessive pressure to be applied to the cables, which broke down.

One accident was due to an official interfering with the switchboard, instead of leaving matters to the attendant-in-charge. The last case nearly resulted in the death of two men. The outside repair gang of a traction system were not notified of the current being left on the trolley wires one night for special reasons. As a general rule the current was switched off from 12 midnight to 4 a. m. The men were working at a feeder pillar, and could not get the front door open. The back

door would open, and they therefore got a crow-bar and tried to force open the front door, incidentally shorting the bus-bars and receiving severe shocks.

We come now to the description of different methods for keeping the number of interferences with the supply of electricity down to the minimum.

Continuous-current generators and motors used in the works.—A weekly insulation resistance test should be taken, using an ohmmeter and generator, the latter giving twice the working pressure of the machine tested. The main thing to find out is whether the machines have an insulation resistance above or below a certain fixed safe limit. All shunt connections on machines should be made with much larger wire than is necessary for current carrying purposes. The cleaners should be warned to keep clear of the wires, and fancy coils and loops should be avoided, especially near any of the gearing connecting the regulating handle on the switchboard with the adjustable resistance.

High-tension alternating-current generators are best left untested, except for an extra-high-tension test immediately after the erection of the machines at the works. Coils will break down quite soon enough without meeting trouble halfway by high-tension tests. A spare generator should always be in readiness for use in case of a breakdown, as with a high-pressure supply, a generator or cable is either good or bad, and the transition from one state to the other is instantaneous.

Batteries are invaluable in central stations. If the generators on load fail, the obliging battery supplies all or part of the system until repairs are effected, although it is overloaded two or three hundred per cent. In a three-wire system, if the balancers break down the battery does the balancing, and if a heavy out-of-balance comes on, it can be dealt with by charging one-half of the battery and discharging the other half. Batteries often get very badly treated, and this is the reason they are in disrepute in many stations. In high-tension supply stations a motor-generator and a battery form a very good combination. Economy can be effected by shutting down the engines at times of very light load, and keeping up the supply by running the motor-generator from the battery.

Cables and wiring in works.—The cables connecting the generators to the switchboard should be of the fireproof class, carried either in troughs or on shelves fixed to the sides of the foundations until they have to rise to the switchboard. They should be fastened to the wall by insulated cleats or lashed to insulators. Where they pass through the floor of the switchroom or switchboard gallery, they should be pushed through earthenware ducts fixed in a vertical position against the wall. The holes should be completely closed by split wooden bushings fitting round the cable; this will greatly decrease the chances of fire damaging the switchboard. In many stations there is a large hole behind the switchboard through which the cables are brought up; in the event of a fire below the switchboard where so many cables, shunt resistances, etc., are placed, this hole acts as a chimney for the flames, and may result in untold damage being done. The writer can call to mind a serious fire that would have done comparatively little harm if earthenware ducts or something similar had been used. Wiring for motors or lights in the stations should all be carried out with screwed conduit, well earthed, and kept quite clear of lead-covered cables if any such are present.

To avoid any possibility of the station being thrown into complete darkness, it should be lighted by two distinct systems. If the station supplies both lighting and traction, a lighting circuit should be taken from the traction supply as well as from the lighting supply.

The motors used in the works should not have circuit-breakers in circuit with them, but clip copper wire fuses fitted with a porcelain handle and shield for protecting the hand. The fuse should be visible, so that the attendant can see if it is getting hot, and plug in another fuse in parallel if he thinks it at all safe to do so. This arrangement would often allow of a motor being kept going during heavy loads, and also permits a fuse being withdrawn and renewed if necessary without stopping the motor.

Efficient means of extinguishing fires should be conveniently situated in every station. Water is out of the question, as it could only be used after all current was cut off. Non-inflammable non-metallic buckets of sand should be placed on the switchboard gallery. Chemical fire extinguishers should be placed at convenient points throughout the works, and care should be taken to see that they are not mere toys but efficient fire extinguishers. The floor round the switchboard may be of wood, treated in such a man-

ner as to render it non-inflammable. The writer has seen such a floor turn black with the heat without catching fire.

Red signal lamps should be fixed in prominent positions in each room of the station, and switched on from the switchboard. The shift engineer or superintendent can thus be quickly summoned in case of accident, wherever he may be at the time.

The writer is of the opinion that traction feeders are the only ones that should be fitted with maximum current circuit-breakers. Generators and balancers should be either fitted with fuses blowing at a considerable overload, or, better still, with some kind of carbon-break switch-fuse similar to the type described recently in this paper as part of the equipment at the new Birmingham station. These act in a similar manner to a maximum circuit-breaker fitted with a time relay, and the first cost is or should be much less.

Lastly, the switchboard attendant should be supplied with an up-to-date, accurate diagram of all connections, and encouraged to get a thorough understanding of every operation he has to perform. He should also study what would happen in the event of an accident occurring, and decide beforehand what he would do in each emergency. This would help to prevent him from losing his head at critical moments and doing reckless things, causing great damage. The subject of this article is a very important one, and whilst nothing new has been brought forward, still, attention may have been drawn to some points that have not received sufficient notice in some central stations.—*London Electrical Review.*

CURRENT IDEAS

For Furnishing More Light, Heat and Power from Central Stations

Organization and Conduct of a New Business Department Suitable for Central Stations in Cities of 50,000 Population and Under

By R. Borlase Matthews, E. E.

It is now rapidly becoming an accepted fact that the incorporation of a "New-Business" Department into the organization of a central station is an absolute necessity. Only a short time ago managers looked askance upon this idea, and though they considered it as possibly a good thing for the large cities, they thought it to be a sheer waste of good money and valuable time in the case of those cities of under 50,000 inhabitants. In time, however, comparisons of the kilowatt hour consumption per capita in various cities, indicated that where an aggressive new-business-getting policy was put into operation, the figures soon increased in a very acceptable manner and likewise the profits, owing to the additional output and the increased load-factor, or as it is sometimes expressed, the smoothing out of the load curve.

Some enterprising managers in a few of these smaller cities were then bold enough to try to adapt to their circumstances some of the schemes that were operating successfully in the larger cities, and found that they were well repaid for their efforts. Others noting their achievements, have followed their example, until now there is a wave of enthusiasm spreading over the country for an energetic new-business-getting campaign. Its evidences are found in the mail of every central station, for at frequent intervals the literature of advertising companies comes to hand, urging the adoption of their newspaper or mail systems of advertising; the manufacturers offer the loan of electrotypes for illustrating newspaper or other methods of local advertising; they also announce that they are prepared to supply literature descriptive of their particular wares, with the name of the central station printed thereon for local distribution—an arrangement which is obviously of advantage to both parties. And they even put forward attractive offers and suggestions for the introduction of their apparatus to consumers on the sale or

return basis. Articles are appearing at frequent intervals in the technical press and special publications are being issued, all bearing on this subject. The manufacturers of incandescent lamps are spending $10,000 to stimulate this kind of work—the National Electric Light Association has appointed a committee to investigate and advise concerning the same matter—all in response to the demand which has arisen for assistance in this new departure.

This movement is no ephemeral change, but rather the evolution which is taking place on the settling down, or rather standardization of the methods of generating and distributing electricity, together with the improved appliances suitable for the consumers' use which are at present available, and the confidence that has now been established in the mind of the general public in regard to the reliability and economy of electric lighting and power.

The need admitted, the question arises as to how New Business and that which is also included in the same term—an increase of existing business, may be best secured. It is a difficult problem, for, in the smaller cities the staff is generally reduced to the point of absolute necessity, owing to the feeling that expenses should be cut down as much as possible, for the profits of a central station business, at their best, are not great. The already overworked force is, at the present time, putting forth its best energies in this direction as far as permitted by the time and attention required for the operation of the generating plant in that manner so essential for the insurance of a satisfactory supply of current to existing customers. The solution seems, therefore, to be rather in the way of a better direction of these efforts by adopting more systematic methods *based on the results of experience obtained in other cities*, so that the best use may be made of the time available. It will, however, generally be found a paying proposition to take on one or more solicitors who can devote their entire time to canvassing. These canvassers need not necessarily be men who require high salaries, as the manager or his assistant can usually give the time required to close the more important transactions.

It is certain that whatever is done in the way of New-Business-Getting must be done in a systematic manner. The lines which should be followed are those which successful manufacturers of various goods have taken. There is a very close comparison between the art of selling goods and selling "juice." The central station has the advantage in that its prospective customers are near at hand, so that many soliciting expenses, or rather wastes, such as loss of time and money in traveling, are eliminated. The field is concentrated and in addition to personal solicitation it may be easily and economically kept alive and interested by judicious advertising in the local press, and by the even more valuable self-recommendation brought about by the high quality and the superiority of the light given over that obtained from other artificial illuminants, as exhibited by the display in the show windows of the leading store-keepers on the main streets. People talk, and if only they can be induced to talk electric light and power the campaign for new business is half won, hence the importance of giving a satisfactory service, and of keeping the possibilities and advantages of electricity well before the general public.

It is impossible to lay down a universal scheme for a New-Business Department that will be suitable for all cities of all sizes, but a general outline may be given, based on the experience of a successful operation in many cities, that can be so modified and adjusted as to meet the local conditions.

The keynote of modern successful business is system, and in these days of keen competition, the more perfect the system, the more prosperous the business. In starting a New-Business Department it is very essential that a good system be employed, for intelligently handled, it will become a great labor and time-saving device.

When the general scheme of the "system" to be adopted has been worked out, a general instruction book should be prepared. Such a book should be of the loose leaf form so that fresh instructions can be added in their correct place from time to time, as the system develops in its details.

It is advisable to maintain duplicate copies of this book—one for the use of employees, and the other for the manager's reference. A book of this description will prove of great value when a new employee is engaged and will generally assist in the smooth operation of the system.

Too much stress must not be laid on the "system," for after all it is but a means to an end; alone it is of very little avail, it must be backed up by sound common sense and good management.

Advantage should be taken of those modern office methods of keeping records—the vertical file with

a separate numbered folder for each name and the card idex. One standard size of card should be used, preferably the 5 inch by 3 inch, of thin material, so that it can be easily used in the typewriter.

Each customer should be allotted a number, to facilitate reference to the records of the accounting department, correspondence, installation data, etc. To the rotation number should be added a letter to indicate whether the building occupied by the customer may be classed as (R) a residence, (S) a store or business place, or (P) a place where power is used.

The first thing that should be done in the actual work of the department is the compilation of a card index of existing customers, as it is essential that accurate information should be on hand ready for the time when the question of an increase in the lighting or power load has to be considered, and also to satisfy the queries usually put by a prospective customer as to what his neighbor is doing. This index should be arranged in alphabetical order of the streets of the city on which the building is located, and not according to the initial letter of the customer's name, or the number that has been allotted to him, since from the point of view of the supply of current, the building is the permanent feature and the occupant merely temporary. On the same card should be placed the customer's rotation number, and a note as to his connection in eqivalent sixteen candle-power lamps and in horsepower of motors installed.

The cards should be distinctively marked by a rubber stamp, say with a broad red band across the center, so that they may be readily noted when placed with cards containing names of those who are not customers.

In the vertical index file, under the customer's rotation number, a form should be kept containing information similar to that sent into the Fire Underwriters' Association when their certificate of inspection is requested. A note should also be made on this form concerning any special application of electric current with any interesting data thereon. The next step is to verify this information by actually visiting the premises of the customer. While it is advisable to get the last mentioned particulars together as early as possible, it is, of course, more important, as soon as the card index of customers is completed, to make a similar index of all buildings and their occupants, within reach of existing service wires. To aid in getting this information together, maps of the distribution system should be prepared, having the primary and secondary lines indicated upon them in different colors.

This list completed, the remaining buildings in the city must be listed in the same way. In both lists the form of illumination employed, with details as to the number of gas jets, mantle burners, average monthly bills, the name of the owner of the building, etc., should be carefully noted. To aid in compiling this information the local directory will afford considerable preliminary assistance, and the telephone book will form a useful check, but they cannot usually be fully relied upon, and it is most necessary to obtain absolutely exact records. Even such an apparently small item as getting a man's initials correctly, and his name spelt properly, is of more importance than appears at first sight, for many men are very sensitive on this point, and to rub a man the wrong way, even in the slightest degree, when soliciting business, is a mistake which should be carefully avoided. A correct and complete record is always of value—anything else is worse than useless.

Having obtained the record, it must be continually kept up to date by following up all removals which take place in the town—information concerning which should be sought in the daily papers, from friendly real estate dealers, contractors, and from all others who are likely to know of such changes.

With the collection of the above-mentioned information, of course commences the real soliciting. The way should be prepared as far as possible by suitable advertising matter, and the day before a call is made a postal card should be sent, making mention of the fact, thus paving the way for a favorable reception.

The most likely field should first of all be attacked, the stores on the main streets and the factories, then the smaller stores and larger residences should receive attention, and so on until the whole town is canvassed. The solicitor when making a call should not omit "to leave his card." The card suggested as advisable would be a postal card, addressed to the central station, and having on the back a printed request for a representative to call, spaces being left for filling in the time and the day which would be most convenient to the sender. This card, if placed by the solicitor on the telephone, will at least, serve as an advertisement and reminder

of the company's existence, even if it is never actually mailed to them.

The solicitor must be provided with a certain amount of ammunition before he makes his call; he may or may not be a technical man, but he must be thoroughly coached and posted in those matters which he has to deal with, for it is fatal if the prospective customer realizes that they are talking to some one who does not know much more about electrical business than they do. In residence canvassing it is well to endeavor to at least arrange to be allowed to present an estimate on wiring the house. The estimate should be prepared in two ways—one with the wiring done in the way that best suits the convenience of the householder, and the other in such a manner that the figure is cut as much as possible, by omitting all lights but those which are absolutely necessary, and also leaving out as many wall switches as possible—thus giving an idea of the minimum price the work could be done for; the lower figure also shows up the difference between necessity and convenience, and puts in a somewhat better light, what at first appears to the average householder to be a very high figure. Chandeliers and other fixtures should always be figured upon as extras, as taste varies so much in the selection of these fittings, and their price added to the cost of wiring, makes the latter appear excessive.

A standard form should be prepared for use in getting the wiring data together, to insure that nothing is omitted, and also so as to see that if the work is bid upon by more than one contractor, they base their estimate on the same specification.

As a rule, it will be found best that the solicitor should not make an estimate at the time of the calling, though it is well that he should be able at times to give an approximate figure, making it quite clear to the prospective customer that this is so, and at the same time making mention that an accurate figure will be presented in the course of a few days' time.

Amongst the information the solicitor has at his disposal should be data as to the average bills of customers, their current consumption per sixteen candle-power lamp connected. The cost of lighting various size lamps per hour, and the cost per hour of operating various heating and cooking devices.

In canvassing stores the data as to the average, the maximum and the minimum consumption per lamp connected, is very valuable, since in the case of any proposed lighting scheme, the monthly bill can be fairly accurately estimated for stores doing the same class of business.

The general policy that should be adopted in soliciting is to see that the customer gets what will be most economical and serviceable, as it pays best in the end, though the load is not as great as it might be, for it means the obtaining of a satisfied customer, which is a valuable asset, since it implies a long continuance of business.

If the solicitor has with him illustrations of some of the principal components employed in house wiring, it will aid much in his explanations of such things as the difference between side brackets and drop lights, between flush and wall switches, etc.

In this connection, illustrated pamphlets could be made good use of, which give general and popular information concerning the method of wiring houses, the location and arrangement of fixtures, switches, etc.; the use of three-way switches for hall lights; the advantages of a pilot lamp for cellar lights; *increased cost of concealed over open wiring;* the possibilities of the motor for driving the sewing machine, the meat chopper and the wringer; also general details of electric heating and cooking devices. A note should be included to the effect that wiring does not necessitate the mess made by plumbers or gas-fitters, and that it does not pull the house to pieces.

Power soliciting is much more difficult than the canvassing in residences and stores. It requires, if it is to be handled successfully, the services of a trained technical man. In the power business is to be found the most paying load of the station, for though the rates obtainable are not high, the demand is spread over a large part of the day. There is not so much difficulty in obtaining power customers where the motor capacity required does not exceed 15-h.p. It is the larger power user who is not easily persuaded to forsake his present power plant. He says the rates are exorbitant, that he can produce power at ten to twenty dollars per horsepower per annum, and proves it to his own satisfaction, by dividing the cost of his fuel by the maximum indicated horsepower of his engine, occasionally condescending to add in the engineer's wages, though reluctantly, as he says he has to have the engineer anyhow to stoke the fire for warming the building. Such men require very careful handling, if they are to be won over.

The best method of dealing with the power situation is to investigate the conditions in each fac-

tory by turn, making tests where possible. The owners are usually quite willing to grant permission for this. Some factory is certain to be reaching the point of overload of its own power plant; this affords the opportunity for the central station. A motor is installed on trial—the inevitable result follows, another motor goes in, until at last, after much expenditure of time and trouble the whole plant is motor driven, and affords an example for other factories.

The installation of a motor, say on a sixty-day trial, is almost invariably a safe risk to undertake. Under these conditions the best method of installation must be insisted upon and every care expended to insure the most economical results, by taking every advantage of the flexibility of a motor drive, and the possibility of cutting out all unnecessary line shafting, for the greater the economy effected, the sooner is the owner convinced of the good value of central station power.

Here again, data as to the current consumption of other customers is of great importance. This should be tabulated in a similar way to that employed by Mr. E. W. Lloyd in his report to the N. E. L. A. in 1905, on purchased electric power in factories. In this report the following headings are used: (1) Kilowatt Hours Per Month, (2) Connected Load in Horsepower, (3) Individual or Group Drive, (4) Number of Motors, (5) Percentage of Average Load to Connected Motor Load. The report referred to is in itself of great assistance, and very useful in backing up local data.

Prospective power customers always wish to know what it is going to cost them per month to run a particular motor, and usually multiply the rated horse-power of the motor by the rate charged for current, which is naturally an excessive figure. The tables mentioned above indicate that the average load on a motor rarely exceeds four-tenths of the rated load, and more usually is in the neighborhood of one-third that load.

Very often steam and other heating systems play a very important part in the operation of a factory, so at the time a motor installation is made it is well to look into this part of the factory economy also, to see that all leaky pipes are calked up and proper steam traps used on all drains. Suggestions should be made for the improvement of the heating apparatus if possible.

Even such a simple idea as to install double windows during the winter months makes quite a difference in the coal pile. Thus, indirectly, the introduction of the motor drive is associated with a general reduction of manufacturing costs.

Circulars and pamphlets, bearing on the use of central station power in factories, keep the manufacturer's interests alive. Illustrations of various applications of motors, though not dealing with the particular business the manufacturer may be interested in, will cause him to think of some machine in his own business to which a motor could be applied in a somewhat similar way. As the number of booklets required is small, the cost of producing special advertising publications for power users is proportionately greater than in the larger field of residence and store lighting, so advantage should be taken of the pamphlets and flyers issued by the manufacturers of motors, who are usually glad to forward copies of the same for distribution.

The special folders and booklets prepared by the various advertising specialists are also very useful.

The small power user often does not use electric power, simply because he does not realize that it can be applied in his particular case, so that it is necessary to bring examples of motor applications to his notice, and make suggestions as to how he could also take advantage of the same power. He is also interested in the cost of such power, and in what his neighbors are doing and paying. Data should be collected of various machines that are specially built for direct driving by motors, for such apparatus is usually more satisfactory driven in this way than with a belt drive. For instance, many grocers rather than operate their old hand coffee-mill by a separate motor belted to it, would invest in a modern direct connected mill, if they only knew of the existence of a neat, efficient and compact machine.

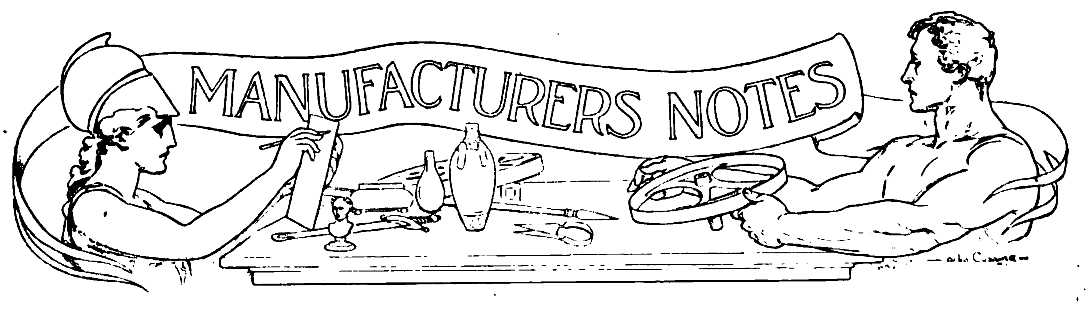
Personal solicitation as here illustrated is much, but it is not all, it needs to be allied with that powerful assistant, newspaper and direct-by-mail advertising. A persistent course of advertising is most important, and not merely the ordinary style, but also that which is educational in its nature, bringing forcibly to the front the many advantages and economies of electric light and power. For it is wonderful how ignorant the residents of the average city still are concerning electricity and its applications. They hardly know whether a store is lighted by electricity or not, though they appreciate the fact that one store is better lighted than another, or

notice that they can match colors more correctly in some stores than in others, but, unfortunately for the central station manager, they do not often realize that the light they find most efficacious, is due to electricity. Therefore, it becomes his aim to enlighten them, figuratively speaking as well as literally.

Local newspaper advertising is of great value and should be regularly employed. The matter should be direct and to the point, giving convincing reasons for statements, not merely making unproved assertions. There must be something about it different from other advertisements, in the same paper, so as to attract attention, and having attracted attention, there should be something worth reading. No advertisement should appear without the full name and address of the office of the central station, not omitting the telephone number.

It is advisable to vary geometric designs with striking cuts. Certain of the manufacturers are glad to provide cuts of their apparatus, and other suitable ones may also be obtained at very reasonable prices from the various advertising specialists. The latter also undertake to supply matter for the body of the advertisement, thus saving the central station manager's time; and owing to its being prepared by men who make the art of advertising their specialty, such matter is usually much more satisfactory than an amateur production. It is advisable, however, for the manager to edit these ready-made advertisements, as they do not always exactly fall in line with local requirements.

Newspaper advertising brings about friendly relations with the editor, a state of affairs which is of considerable value, as in an indirect way it is apt to lead to the modification of many of those careless and sensational paragraphs which come into the editor's hands, from time to time, and do a good deal of damage to central stations by exaggerated accounts of mishaps or by wonderful theories on the municipal ownership of public utilities. Advantage may also be taken of these friendly relations to supply the editor with interesting paragraphs, "readers" and "fill-ups," dealing with electrical matters in general, all of which tend to the general awakening of public interest in electrical supply.



The Hartford Time Switch.

The rapidly increasing use of time switches throughout the country has resulted in a demand for automatic time switches to do more than merely turn on and off the current daily, and this demand has been well met by the Hartford Time Switch Co., 97 Warren street, New York, which has now five different types of switches to meet the special requirements of different users. The latest type produced by them is adapted particularly for apartment house use in lighting the halls. The method of operation is as follows: The first throw at dusk throws on the main lights through the halls, at midnight, or at the hour desired, these lights are turned off, and, at the same time, one small light in each hall is turned on; at daylight these small lights are turned off and this method of operation is carried out each night without further attention than the usual weekly winding of the operating clock. The time of operation can be changed by the user for any time to suit desired conditions.

The accompanying cut shows the extreme simplicity of the complete switch, and the makers par-

ticularly wish to call attention to the following points: That the time, or clock portion of the mechanism has no work to perform further than to keep time, as the motor section is entirely distinct from it; the connection being similar to that between the time and strike sections of a striking clock, though, as used in this mechanism the time side only does one twenty-fourth as much as in a strike clock. By this almost complete separation, perfect regulation and time-keeping qualities can be obtained from the high-grade Seth Thomas clock used.


THE HARTFORD TIME SWITCH

The connection between the motor and the switch is obtained through the slow unwinding of a heavy spring and the instantaneous action of a very light spring. The result is an extremely quick breaking switch, the avoidance of any possibility of a short circuit, and the total elimination of any blow or thump by the switch action.

The entire mechanism is enclosed in a dust and weather-proof case of japanned cast iron, the switch proper is enclosed in a separate insulated cover, and the outer door of the case is locked with a sub-treasury tumbler lock.

The standard switches manufactured by the Hartford Time Switch Co., include a switch for turning the current on and off each night in the week; one that automatically omits the switch operation on Sunday; one particularly designed for operating street lights; one that throws the current on for two periods each night for use in stores and on signs where the attention of theater-goers is desired; and the one for apartment houses more particularly described above. They state that they have designed many switches to fill different requirements, and that there are few conditions that they cannot arrange their switch to meet.

Hartford Time Switches are manufactured in single, double and triple pole up to 35 amperes capacity, in single and double pole in 50 amperes, and all switches are fully tested before shipping.

The Chase-Shawmut Company, of Newburyport, Mass, has just issued a folder describing their patented Extended Terminal Fuses.

Before the advent of National Electric Code Fuses the manufacturers of enclosed fuses made a type "A" or screw clamp contact fuse. In developing these fuses the manufacturers, in many cases, made them up in different lengths for fuses of a given capacity. This fact has continually been a source of annoyance.

To obviate this, and to reduce and simplify the stock of type "A" fuses necessary to have on hand, the Chase-Shawmut Company has developed and completed a line of fuses having a long or extended terminal on one end. This terminal is made of soft copper and scored at different standard lengths. After once fitting the fuse to the base, the projections may be removed with pliers or hack-saw. This fuse will reduce the stock necessary to be carried by the central station to one-third of the amount of fuses carried before this extended terminal fuse was developed.

The Cleveland Gas & Electric Fixture Company, formerly of Cleveland, Ohio, is now established at its new factory at Conneaut, Ohio.

The above company has erected at this place, which is sixty miles east of Cleveland, an entire new factory which contains 75,000 square feet of floor space, and is fitted throughout with the most modern machinery essential in the manufacture of their "C" box line fixtures, and at the same time are provided with excellent shipping facilities. The factory is now in a position to deliver promptly orders for their "C" box line fixtures, and they are soon to place upon the market a more elaborate line of these gas, electric and combination fixtures, until all the requirements in the fixture trade are covered, for low and medium-priced fixtures.

Pettingell-Andrews Company, of Boston, Mass., the largest electrical supply house in New England, is now placing upon the market four new and important central station devices, which will be illustrated and described in subsequent issues of this paper.

One of these devices is their O. K. ground connection clamp, suitable for use on all kinds of pipe or lead cable. The illustration shows this clamp in

GROUND CONNECTION CLAMP

position on an iron pipe, with the grounding wire in position and parallel with the pipe itself. The extreme simplicity, ease of installing and permanent and ample contact, is seen at a glance. The clamp is made of hard drawn copper sheeting, thus having the required flexibility to admit of its being sprung over the pipe or the lead sheathing of the cable which is to be grounded. The terminal of the ground wire extends the entire length of the clamp, and in such a way as to be easily and permanently soldered in position. The small screw bolts which are furnished to hold this clamp securely to the pipe or cable have their ends upset at the factory, making the clamp self-contained and always ready for immediate use.

The flexibility of this clamp adapts itself especially to the ordinary variations in pipe sizes, and can be readily put on or taken off pipes or lead cables without any possibility of damage to either of the latter. These clamps are made in eight different sizes, for use on pipes or cables from one-half inch to three inches in diameter.

Sales of White Star Oil Filters by the Pittsburgh Gage & Supply Co., Pittsburgh, have been made recently to the following concerns:

Eleanora Mines, R. & P. C. & I. Co., Eleanora, Pa.
Donohoe Coke Co., Greensburg, Pa.
Wm. H. McCarthy, Pittsburgh, Pa.
Pittsburgh Steel Construction Co., Economy, Pa.
Penn. R. R., Pittsburgh Shops, Pittsburgh, Pa.
Trumbull Electric Mfg. Co., Plainville, Conn.
Powell, Clouds & Co., Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Pittsburgh Steel Co., Monessen, Pa.
John A. Roebling Sons Co., Kinkara, N. J.
Bryan-Marsh Electric Co., Central Falls, R. I.
Louisville Lighting Co., Louisville, Ky.
Auburn & Alton Coal Co., Auburn, Ill.
Laurel Mfg. Co., Laurel, W. Va.
American Steel & Wire Co., Chicago, Ill.
Cartersville & Big Muddy Coal Co., Carterville, Ill.
Russell Coal Mining Co., Clymer, Pa.
Milburn Wagon Co., Toledo, O.
Pittsfield Electric Street Railway Co., Pittsfield, Mass.
Cincinnati Waterworks, Cincinnati, O.

The progressive spirit of the management of the Erie R. R. is well illustrated by the illumination of their new terminal at 23rd street, New York. After careful consideration their Electrical Department selected the Excello Flaming Arc for lighting the ferry slips, cab stands and concourse. Although there are only comparatively few lamps installed, the results, particularly as regards lighting efficiency, have been highly satisfactory, both to the patrons and officials of the road. Excello Flaming Arcs are used in this installation both for inside and outside illumination.

Additional similar installations are being made at the Chambers street and Jersey City terminals

Great credit is due to the Erie R. R.'s Electrical Department, for the careful and thoroughly modern ideas displayed in all methods of handling the new illuminants in various forms.

Particulars about the Flaming Arcs used in this installation may readily be obtained from the Excello Arc Lamp Company, 24-26 East 21st street.

Dunton & Field, of 117 Main street, Cambridge, Mass., are meeting with great success with their Dunton tree insulator.

This tree insulator is the only one on the market that allows the wire or cable to be tied in solid to

DUNTON TREE INSULATORS

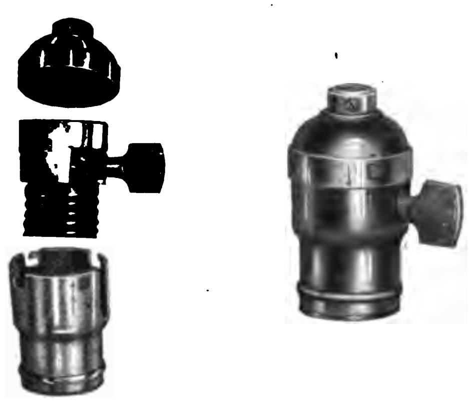
the glass without injury to the wire or the tree, as will be seen by illustration. The insulator arm, which is made of the highest grade of malleable iron, swings on a sleeve which is lag-screwed to the limb of the tree. By the use of a similar sleeve, it supports a standard locust pin, to which the glass insulator is attached, enabling the latter to remain always in a vertical position when tied to the wire. Any form of insulator, whether the ordinary single, double or triple petticoat that fits a standard pin, can be used with a Dunton tree insulator.

The application of these insulators is shown in the accompanying photograph of an actual installation which, before these insulators were used, was a source of the greatest annoyance to the central station management, owing to the chafing off of the instulation of the feeder cables, causing annoying, wasteful and dangerous grounds. The manufacturers issue an attractive little pamphlet of these insulators, giving the prices as well as a number of endorsements from some of the most prominent electric lighting and power stations in the country, which are enthusiastic in their praises of this new and valuable protector of their outside line construction.

General alternating current data are given in Bulletin 74, just published by the Crocker-Wheeler Company, Ampere, N. J., entitled "Engine Type A. C. Generators." This gives the bulletin value for all who have to do with alternating current. A number of views are shown of plants where Crocker-Wheeler alternators are installed, and the bulletin also goes into details describing the design of generators developed by the company. C-W engineers began designing A. C. machines about three years ago when the company had had fifteen years of highly successful experience in D. C. design and manufacture. They based their work upon the designs of the celebrated Swiss electrical engineers, Brown, Boveri & Cie, acting under license from the Swiss firm. They therefore entered the field of A. C. manufacture unhampered by a costly stock of old designs, drawings and patterns, and were able to incorporate new and useful ideas in this class of machinery. The company met with instant recognition in this field and has accomplished remarkable results especially in plants where the generators are driven by gas engines. One of the marked peculiarities of C-W alternators is their ability to operate in parallel; it was largely for this reason that the California Gas & Electric Corporation installed three 4,000 K. V. A. Crocker-Wheeler alternators in its San Francisco plant. There are the largest generators ever built for gas engine drive.

A new socket known as the "Security Snap" socket, which does away with the inconvenience of the screw fastened type, has recently been perfected by the General Electric Company. Such a device has been particularly needed in fixture work where it

is very inconvenient to adjust an ordinary screw jointed socket in the husks. Moreover, the "Security Snap" socket is so constructed that it is not necessary to tip the shell to make the fastening. It



THE "SECURITY SNAP" SOCKET

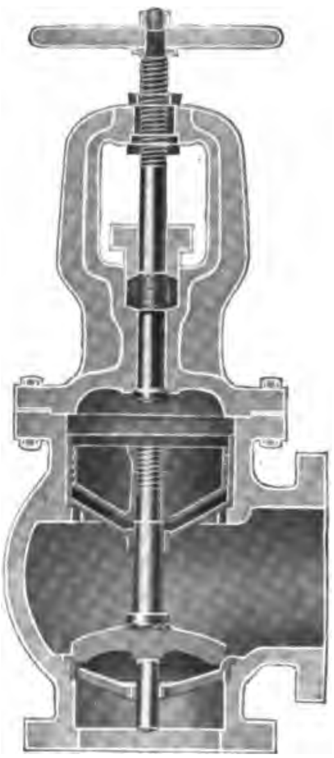
may, therefore, be used in small husks as conveniently as in large.

Reference to the accompanying illustrations will make the construction of the new socket clear. The security of the bayonet joint is combined with the convenience of a spring snap connection. In order to facilitate the assembly of the socket, the cap and shell are marked with arrows and a star. To disunite the socket, the thumb is pressed on the star, the arrows brought into line, and a straight pull brings the socket apart. In assembling, the cap and socket are arranged with arrows in line, the shell is inserted in the cap, and turned until the socket locks.

As the shell is fastened by three bayonet joint catches, the connection is rigid, and the joint is held securely by the automatic lock.

The Anderson Cushioned Non-Return Valves.

These valves supply a vital part of the general piping system of power stations regardless of the size of plant or the pressure. They are designed and made to meet the demands of steam and mechanical engineers for a high-grade automatic valve, adapted to high steam pressures, and especially a valve that will not chatter, hammer or stick, and that will be positive in case of accident. As the valves are heavy, it is not expected to compete in price with ordinary non-return or automatic stop and check valves on the market. These valves, when placed between the boiler and header, will equalize the pressure between the different units of a battery of boilers, as they remain closed as long as the boiler pressure is lower than that of the header. When the boiler pressure equals the header pressure, they open and remain in that position without chattering or hammering. They will automatically cut off a boiler in case of accident, such as the bursting or collapsing of a tube, and will also act as a safety



ANDERSON CUSHIONED NON-RETURN VALVE.

stop to prevent steam being turned into a cold boiler.

Referring to the sectional cut, interest centers in the dash pot arrangement for cushioning the

valves, which is so essential in order to avoid the chattering, hammering and sticking existing in this class of valves. The inside bronze dash pot is firmly attached to the valve spindle, while the one outside, also of bronze, is loose on the spindle and free to move in the body. In a word, "A Corliss dash pot" occupying the full area of the body, thus insuring the perfect cushioning feature and the perfect alinement of the valve with the seat at all times, regardless of position. When the steam pressure raises the valve, there instantly exists the resulting space between the inner and outer dash pots and the latter, being loose on the spindle, allows steam to pass between the dash pots, and around the outside dash pots through the several vertical grooves cut in the upper portion of the body. Condensation is eliminated by this means. These valves are made of cast iron, semi-steel or steel and fitted with brass, bronze or nickel bronze in accordance with specifications. They are especially adapted for high pressure and superheated steam service and are made by the Golden-Anderson Valve Specialty Co., Pittsburg, Pa., 1011 Fulton Bldg., who also make the Anderson automatic float valves and traps.

The Compania Electrica e Irrigadara of Pachuca, who for about six years have been supplying to the city of Pachuca electrical energy for power and lighting in that city from their Juando generating station, have now in process of construction a new plant, the Elba Generating Station, which has been found necessary to supply the rapidly increasing demand for power in Pachuca.

The new Elba generating station is located on the same stream as the Juando Station, this stream being the waters of the drainage canal from Mexico City. At the Juando Station there is in operation approximately, 3,000 h.p., comprising six 375-kw. Westinghouse generators. The generators supply the energy at 440 volts, which voltage is raised to approximately 25,000 volts, 3 phase, by means of various banks of large transformers.

At the Pachuca end of the transmission line this voltage is reduced to 2,200 volts for general distribution to the various customers.

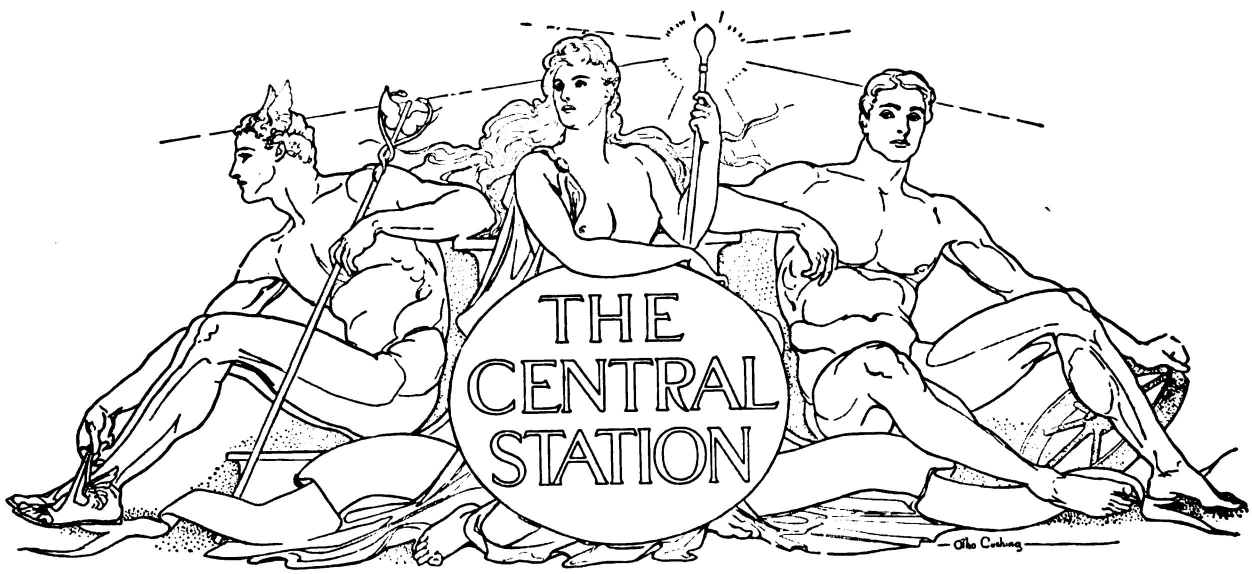
James Blake Cahoon, Ex-President of the National Electric Light Association, and Chief Engineer of the Eldenbel Construction Company, of New York City, died at his home at New Rochelle, N. Y., on February 20. Mr. Cahoon was born in Lyndon, Vt., in 1856, and was a grandson of the Hon. J. B Cahoon, at one time Mayor of that city. Mr. Cahoon graduated with honor from the Naval Academy at Annapolis, and while detailed at the Torpedo Station, at Newport, R. I., received injuries in the course of his electrical experimental work, which

JAMES BLAKE CAHOON

resulted in his retirement from the Navy. He later was appointed Superintendent of the Expert Department of the Thompson-Houston Electric Company, afterward the General Electric Company, at Lynn, Mass., and later at Schenectady, N. Y.

Mr. Cahoon resigned his position with the General Electric Company to take up consulting engineering, and was retained by several of the largest banking houses in New York City as their expert on electrical properties in which they were interested.

The loss of Mr. Cahoon is deeply felt by a host of friends and associates in the electrical engineering profession.



DEVOTED EXCLUSIVELY TO THE INTERESTS OF ELECTRIC LIGHTING AND POWER STATIONS.

VOL. 6, NO. 10. NEW YORK, APRIL, 1907. ISSUED MONTHLY

Central Station Light, Heat and Power Principles

By Newton Harrison

A brief outline of the principles of operation of the motor, which has proven to be so large a department of the consumption of current in central station service, shows clearly the reasons why it has become specialized in so many distinct forms. One of the most noteworthy is the fan motor of a large and small type. The great pressure blower or exhaust, and the more conveniently handled fan motor proper, are best understood as far as their control and application are concerned, with respect to the underlying principles given in the following:

The Back E. M. F. of a Motor.—The adjustment which takes place between the load of a motor and the power it consumes is brought about by means of the back electromotive force.

This E. M. F. is developed within the armature for the same reason that any other E. M. F. is generated in conductors cutting a magnetic field. The armature of the motor, though caused to rotate by the reaction between the field of the magnets and the field of the conductors, nevertheless presents the case of free conductors rotating in such a manner that the lines of force they meet are cut and necessarily produce E. M. F.

It is a simple matter to calculate this back E. M. F. by multiplying the revolutions per second by the number of conductors by the lines of force of the field and dividing by 100,000,000.

The conditions which exist within the armature of a motor when in action are as follows: Current is allowed to enter the motor, energizing the field magnets, and passing through the armature in a limited manner. The rotation which then ensues is the means of generating an E. M. F. within the armature conductors. There is, therefore, two electromotive forces in action within the armature; one of which tends to send a current through it, and the other, which opposes or counteracts the effect of the entering E. M. F. If the E. M. F. *generated* within the armature conductors is called the back or counter electromotive force, the E. M. F. applied to the motor can be called the line or impressed E. M. F.

How the Back E. M. F. Varies.—A study of E. M. F. with respect to its generation by means of motion, lines of force, and conductors, shows how variations in the amount of E. M. F. developed may be brought about. Any increase in the number

of conductors on the armature of a motor will give rise to a higher back E. M. F. Any change in the speed of a motor will give rise proportionately to an equivalent change in the back E. M. F. of a motor. And finally any increase or decrease in the strength of the magnetic field will be the means of causing a change in the back E. M. F. These influences are thus referred to because the regulation and operation of motors is dependent upon these principles not only in theory but in actual practice.

Load and Back E. M. F.—When an impressed E. M. F. acts upon the field and armature windings of a motor, current is sent through the first, producing a field of given strength, and through the second, developing rotation and its concomitant power. The remarkable fact about the work a motor is doing and its back E. M. F. is this: When the motor is running free or "idle" as it is called, the motor is developing the highest back E. M. F., and in consequence the impressed E. M. F. is only able to send a small current through the armature. The effective E. M. F. in this case is the *difference* between the impressed E. M. F. and the back E. M. F. This effective E. M. F. will send a current through the armature, which is governed by the resistance of the same. For instance, if the armature has a resistance of .01 of an ohm, the impressed E. M. F. equals 110 volts and the back E. M. F. equals 109.5 or 109.75 volts. The difference between 110 and 109.5 volts is .5 volts, which, with a resistance of .01 of an ohm would mean a current of $.5 \div .01 = 50$ amperes. The difference between 110 and 109.75 volts is .25 volt, and this would send a current through the armature of $.25 \div .01 = 25$ amperes. Therefore a very low resistance armature needs but a very small effective pressure to send a heavy current through. The frequent changes of load to which a motor is exposed will when taking place, vary the speed slightly. If the load is reduced the speed will increase, and if the load is increased the speed will diminish. It is thus evident that the back E. M. F. will vary accordingly, and that less or more current will pass through the armature The back E. M. F. therefore acts as a natural automatic valve which opens wider when the load on the motor is increased and therefore more current is required, and which, so to speak, closes when the load on the motor is diminished and less current is required.

Kinds of Motors.—The motor is divided up into classes according to its winding, and the character of the current employed for its operation. The direct current is used for motors wound as follows.

1. Constant current series wound motors.
2. Constant potential shunt wound motors.
3. Constant potential differentially wound motors.

Each of these types is distinct, as far as its winding is concerned, although the last is a combination of the first two, that is, shunt and series winding. Series wound motors are employed on direct current circuits which supply constant current and constant potential. Both high tension arc light constant current systems make use of them, and street railway 500-volt constant potenial systems. The shunt wound motor is used for stationary work, such as the running of machine shops, printing presses, etc. It is, of course, possible to install series motors as well, in the places mentioned, but then there is present the ever attendant risk of high potential circuits. The system, therefore, best suited to a city's needs, is a low and constant potential system, such as is found at present installed in New York.

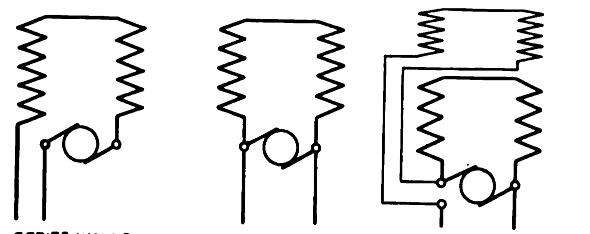
Speed of Motors.—The question of speed is a very important one in connection with motor design and construction. The two possibilities open in this direction are *constant* speed and *variable* speed. As speed in a motor is controlled by the parts which give rise to it, namely, the armature and field; and as the power of these is dependent upon the current in the armature and the strength of the field, it is evident that the question of speed is largely solved along these lines. Speed in a motor can be controlled and varied by placing a resistance in series with it and thus governing the volts and amperes it receives; but automatic control is perhaps better represented in such cases when a constant speed is desired by differential winding.

The ordinary type of shunt wound motor possesses a fairly constant speed when the load is increased or diminished, whereas the series wound motor will increase in speed as the load is reduced, and decrease in speed as the load is increased.

A differentially wound motor, as its name implies, is one constructed with a differential field, that is to say, a field whose magnetic strength is increased or diminished, not with the increase of the load, but reversely. In a motor of this type of winding, its field is weakest when its load is greatest, and its field is strongest when its load is least. Thus, it seems that the question of speed is largely dependent upon the relationship between the load of a motor, its strength of field and the impressed E. M. F. sup-

plied to it. Changes in these will mean changes in speed, and by such means, it may be said, the purpose of a motor is outlined, whether for constant speed or variable speed, with a constant load or a variable load.

The Series Wound Motor in Service.—To understand the service for which a series wound motor is



best suited, it is necessary to understand the influence upon it of more or less volts, more or less current, and a heavier or a lighter load. To begin with, the very nature of a series winding calls for the same current in both armature and field. This fact is emphasized in order to show how responsive the motor is to such changes as may occur in the back E. M. F. of its armature. The current which passes through a motor may be determined by the formula:

Current = (Impressed E. M. F. — Back E. M. F.) ÷ Resistance.

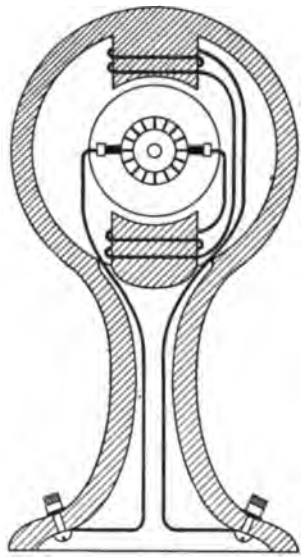
$$\text{Amperes} = \frac{\text{Volts of Line—Back E. M. F.}}{\text{Resistance in Ohms.}}$$

Supposing a series motor has a resistance through armature and field of 2 ohms, and its armature develops a back E. M. F. of 400 volts; then if the impressed or line pressure is 500 volts, the current will be:

$$\text{Amperes} = \frac{500-400}{2} = 50$$

Examination of this formula will show that if the resistance is increased, the amperes will diminish; also that an increase in the back E. M. F. will reduce the current. It will show in addition, that if the volts supplied to the motor are increased, more amperes will flow; there will, therefore, be more torque or pull to the armature, and in consequence a higher speed. Increasing the pull of an armature by increasing the impressed pressure, by reducing its back E. M. F. are clearly shown in the formula by the increase of the amperes which would thus result.

Manipulation of the field strength is the means employed for affecting the back E. M. F.; in this case if the field is cut down either by shunting the field winding or by short circuiting part of the lines of force, less lines of force are cut by the armature conductors and a lower back E. M. F. is produced. More current cannot pass in if the machine is series wound and fully loaded on a constant current circuit. Therefore, under such conditions, with a weakened field its pull would be reduced and its speed slackened. A series motor increases in speed as its load is reduced, and diminishes in speed as the load is increased. A reduction of the load causes the then present pull of the motor to increase its speed; this also increases its back E. M. F. and consequently reduces the current in both armature and field. Although there is now a weaker field due to fewer ampere turns on the field magnets, there is a higher speed. A still further reduction of the load



SECTION OF A SERIES WOUND FAN MOTOR

will increase the speed still further, until if the motor is entirely without load, it will run fast enough to destroy itself.

Series Wound Fan Motors.—Fan motors are series wound as a rule, unless they are to serve a different purpose from that of only running fans. A series wound motor must always be doing work when in operation, and the presence of a fan, therefore, represents a load which enables it to comply

with the requirements of practice. Different speeds are obtained by means of a switch which governs resistance in series with the motor. At the two or three points indicated, the switch allows a current of greater strength and pressure to enter, which with the fan load permanent, permits of a higher speed.

A series wound motor for the driving of sewing machines or light loads, could not be used unless there was a certainty of the load never being removed; otherwise the armature of the motor would fly apart. This form of service calls for a motor which can meet conditions of full load or no load without such an abnormal development of speed.

Prepared for THE CENTRAL STATION by Colin P. Campbell, Attorney.

Negligence in Permitting Wiring to Remain After Service Discontinued.

This case while involving a telephone company is on a point which may well arise in the experience of electricity producing companies, consequently, while the case is not given in full, there is enough given to show the point involved and the reasoning and conclusions of the court.

Plaintiff agreed with a telephone company to connect his house with the exchange for a monthly rental. At the end of a year he requested the removal of the telephone. Employees of the telephone company took out the telephone box but suffered the wires to remain. Later lightning struck a tree near the house and passed from it onto the wires and did considerable damage to the house. Action was brought to recover the damages sustained, and these and the following additonal facts were proved. The wires had remained in the house about ten months after the telephone box was removed. The owner of the house knew that the wires were there but did not ask to have them taken out. The court directed the jury to find for the defendant and this they did and plaintiff appealed.

In the Court of Appeals defendant insisted that the loss was due to the act of God and that plaintiff was as much responsible for the trouble as the defendant. The Court said that "While lightning is the act of God, the carrying of the lightning in the plaintiff's house on its wire which it had left attached ta plaintiff's house, was the act of the defendant, and it was a question for the jury whether defendant had used such care as might be reasonably expected of a person of ordinary prudence under the circumstances. The plaintiff had ordered the defendant to take out both the box and the wires and it was a question for the jury whether he by his want of care contributed to the loss, or acquiesced in the wires remaining in the house when he knew, or by the exercise of ordinary care, should have known, the danger. He had once notified the company to take out both box and the wires, and, though he knew that they had not complied with his request he may not have known that the wires were so left as to be a source of danger. Under such circumstances the rule is that in placing wires for conducting electricity into a house the company owes the persons living therein the exercise of reasonable care, proportioned to the known dangers of the conditions to prevent the wires acting as conductors of lightning into the building, and it is liable for damage resulting from neglect to provide against this danger. Especially is it liable when damage from lightning occurs from its failure to

remove the wires when the person living in the house has ceased to use its service. The judgment was accordingly reversed. Evans v. Eastern Kentucky Telep. &c. Co. (Ky.) 99 S. W. Rep. 936.

LIABILITY FOR INJURIES FROM SHOCK—MEASURE OF DAMAGES—EVIDENCE.

Plaintiff was injured by a current from defendant's conductor. The liability was not questioned, but its amount and the elements to prove it were the points contended upon. It appeared that previous to the accident plaintiff was a strong, healthy girl, that since then she had suffered from a nervous affliction, spinal curvature, enlargement of one side of the chest, excessive nervousness and improper nourishment. The jury awarded $3.750, and the court thought the amount moderate on the facts detailed. The court also held that it was proper to go into the details of the treatment which the child required in order that she might recover, for the purpose of giving the jury an idea as to the length of time plaintiff would suffer, and also as to the proper treatment. The court said, however, in passing, that the defendant could not be charged in this action with the expense of the treatment, as this was an action by the child. The parents would be bound to cure the child, and the company's liability would be to the parents for this. Physicians testified as to the results of such injuries and the probability and length of time necessary for a cure. The court then said: "Without going further into the testimony, it is sufficient to say that some of these expert witnesses testified that under favorable circumstances the child might become cured within a year, or two or three years; some that under certain circumstances the effect of the shock might remain through womanhood. Therefore the court would not be justified in saying that the plaintiff would in all probability entirely recover within two or three years, and that she was not entitled to recover as for permanent injuries." The judgment was therefore affirmed. Colorado Springs Electric Co. v. Soper (Colo.). 88 Pac. Rep. 165.

Validity of Exclusive Grants—Continued.

In the last article we discussed several cases involving a decision regarding the validity of exclusive grants of electric or like franchises. We believe that the importance of this subject warrants a continuance of this discussion, for in this age of sharp competition an exclusive franchise if valid is a valuable asset.

In some of the States the Constitution prevents the grant of exclusive franchise and care must be taken to learn whether there is any such impediment before seeking or accepting such a franchise. These provisions are, however, sometimes peculiarly construed and there is occasionally a way around pointed out by the court; thus the old Constitution of Missouri forbade the granting of any exclusive privilege and the court held that this as well as the rule against monopolies, forbade the granting of an exclusive right to manufacture and vend gas in a city. The court, however, went further in this case and said that as there was no natural right to use the streets for mains and conduits, such use could be given to one company to the exclusion of all others, and the court would hold this portion of a franchise valid to exclude others from the use of the streets as against the charge that it is a monopoly, although the other portions of its franchise granting it the exclusive right to make and vend gas is held void. The result is that under this rule anyone may make and offer gas for sale, but the courts will uphold the exclusiveness of the first franchise. This, however, raises another point which is, Can the city be prevented from granting another the right to use the streets, because it has previously made an exclusive grant? This question is raised in the case under discussion, but is not decided, the court contenting itself with raising the point and then saying that in some jurisdictions the exclusive franchise has been held not to be a contract and that the city may grant the use of its streets to another. In our case however, the court granted an injunction restraining a competitor from using the streets and upheld the franchise.—St. Louis Gas Light Co., St. Louis Gas Etc. Co., 16 mo., App. 52.

Similar to the case just discussed is an old one in New York in which it is held that the grant of an exclusive right to use the streets is valid. People v. Bowen, 30 Barb. (S. Ct.) 24. In a later case, however, such an exclusive grant was held void, the court holding that it was beyond the power of the board of the town to make, and saying that its tendency was to create a monopoly. The court also goes further and says that such a contract which was that no other company should have the consent of the board to use the streets for the laying of pipes and mains, expired when the board was abol-

ished by a statute annexing the town to a city.—Parfitt v. Ferguson (App. Div.), 38 N. Y. Supp., 466.

Another leading case was decided in Texas in 1887; under this the city of Brenham granted a water company the right to supply the city with water for domestic and other uses and for the extinguishment of fires for twenty-five years. The court said that the language employed in the ordinance clearly evinced the purpose to confer on the water company the exclusive right to furnish the city of Brenham, and its inhabitants with whatever water might be needed or necessary to be furnished by such system for a period of twenty-five years. That the charter of the city conferred on the city the power to furnish the water and this included the power to contract with some other corporation having power or with some other person to supply the water. That no express power was conferred on the city to make a contract giving to the water company the exclusive right to furnish the city and its people with water at a fixed rate for twenty-five years and no power to make such contract was necessary or essential to the exercise of the powers granted; and as the ordinance would have the effect not only to embarrass the city in the exercise of the powers conferred, but to withdraw from it the right to supply water in any other authorized way, for public purposes, and for the inhabitants of the city, which was the soie purpose for which the power to erect, maintain and regulate waterworks was given to it. Consequently such ordinance must be held void and does not have the effect of granting an exclusive franchise as this would create a monopoly which is opposed to free government.—Brenham v. Brenham Water Co., 67 Tex., 542.

Similar questions have been raised with reference to subways, and it has been held that the public may not grant an exclusive right to use the streets to an electric or subway company for the purpose of placing subways in the streets.—State Ex. Rel. St. Louis Underground Service Co. v. Murphy (Mo.), 34 L. R. A., 369.

In North Carolina grants of exclusive franchises have been held void under the provision of the North Carolina Constitution, prohibiting monopolies and the court said in deciding this case that the argument that such exclusive grants are necessary in order that the investment of capital may be induced, is not sufficient to prevent the rule against monopolies from being enforced—Thrift v. Board of Commissioners of Elizabeth City (N. C.), 30 S. E. 349. But in Pennsylvania where the city of Philadelphia leased its gas works with an exclusive privilege to a corporation, the court said that in making this exclusive grant the city acted in its business capacity and was bound by the contract, but that this did not prevent the legislature from granting another franchise, which would compete with the city's lessee.—Bailey v. Philadelphia (Pa.), 39 Atl. 494.

The 30th Convention.

To the Members of The National Electric Light Association:

The Convention will be held at Washington, D. C., on Tuesday, Wednesday, Thursday and Friday, the 4th, 5th, 6th and 7th of June, 1907. The program as to the hours and number of sessions has not yet been decided upon, but from the material already in the hand of the President and with other timely and valuable papers coming, it is expected that this will be an interesting and profitable Convention in every way.

The business headquarters of the Convention, together with the exhibit and meeting halls, will be at the New Willard, corner Pennsylvania avenue and Fourteenth street, about midway between the Capitol and the White House. The Secretary's headquarters for the registration of members, securing badges and general information, will be located on the tenth floor next the exhibition hall. The Master of Transportation will also have headquarters adjoining. The sessions will be held in the smaller ball-room, which has ample seating capacity, and being located on the highest floor, is open on all sides for light and air.

The Committee on hotels has already made reasonable reservations for members and full details concerning hotel accommodations, rates, etc., will be sent to members later, in a special circular on this subject. The large number and variety of hotels in Washington, however, gives assurance that everyone can be accommodated according to his desires both as to location and rates. Those who know the hotels, and care to do so, may make reservations now, addressing the Committee at the office of the President of the Association, 55 Duane street, New York, stating the number of rooms, whether with or without bath, and the rate desired. It is desirable to have as many reservations in advance as practicable, and well in advance of the day of the meeting assignments will be checked and verified carefully, so as to avoid confusion and misunderstandings upon arrival.

The Master of Transportation, Mr. George F. Porter, is now arranging for special railroad rates from different parts of the country. It is to be hoped that we shall have large and representative delegations from the various sections. If a sufficient number can be secured from the large centers, undoubtedly arrangements can be made for special cars from those points. Details as to transportation will also be the subject of a special circular later.

Following the plan of last year, arrangements are being made for an exhibition of our associate members. For this purpose the large ball-room of the New Willard, having a floor area of approximately 10,000 square feet, has been secured. This room is on the same floor with the hall in which the meetings will take place and ample elevator service at both ends insures to each section about equal value from the standpoint of attendance and display.

A departure from last year's practice will be made in the renting of sections, in that the price will include the erection of booths, wiring and lighting. This will eliminate the annoyance incidental to contracting separately for each item. The prices have been fixed at one hundred dollars for wall sections, and one hundred and twenty-five dollars for center sections.

A circular incorporating all the details relating to the Exhibition will be sent shortly to our associate members. In the meantime it would be well for those who desire, to communicate with the Vice-Chairman of the Exhibition Committee, Mr. Walter Neumuller, 55 Duane street, New York City, for reservations.

It is expected that the rental to be derived from exhibits will not much more than pay the expenses in connection therewith. The Committee is striving in every way to make this Convention a success. The plan inaugurated by the Association last year of meeting the expenses of the convention, rather than allow the Local Company to assume such burden, will be followed this year, and we have again decided to ask that the Convention expenses be met by individual company subscription. These may be sent to our Treasurer, Mr. W. C. L. Eglin, who has kindly consented to serve as Treasurer of the Convention. All subscription for the Convention will be applied solely to that purpose and, subject to the action of the Executive Session, any surplus will be returned pro-rata to the individual subscribers.

While it is expected that this meeting will not fall behind any previous one in its reputation as a "working convention," still the location selected this year, surrounded as it is by objects of national and historic interests, gives ample assurance that opportunities for entertainment will not be lacking. In addition to the many buildings and other objects of interest in Washington itself there are many nearby places which can readily be reached, such as Mount Vernon, Marshall Hall, Mt. Arlington National Cemetery, Fort Meyer, Old Point Comfort and the Jamestown Exposition.

Trusting to have your active and earnest coöperation to make this Convention a success in every way

Very respectfully, DUDLEY FARRAND,
Chairman Convention Committee.

The National Electric Light Association, which for years past has occupied offices in the Electrical Exchange Building, 136 Liberty street, New York City, has moved into the new Engineering Societies' Building, which will hereafter be the headquarters of all the leading technical societies and bodies having headquarters in New York. Of late years the association has rapidly outgrown its old offices, and has therefore been prompt to avail itself of the splendid facilities presented in the new home for engineering provided through the generosity of Mr. Carnegie. It occupies four handsome and commodious rooms on the eighth floor of the building on West 39th street, with a fine lookout over Fifth avenue, the East River and Long Island. With regard to light, air and sunshine the location leaves nothing to be desired.

The Central Station

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NOTICE.

Advertisements, Changes in Advertisements, and Reading Matter intended for the next month's issue should reach this office not later than the twenty-fifth of this month.

No commissions are allowed on advertising contracts or subscriptions.

Entered at the New York Post Office as Second Class Mail Matter.

Feeders for Power Houses.

As a rule, feeders are tapped every half mile or less, and by this means the pressure is preserved at a fairly uniform rate. The use and abuse of feeders would form an interesting chapter in the history of street railways, were all records collected and tabulated regarding their proper and their questionable application. To determine the correct size of feeders, it is well known that the ampere load, and the distance from the power house must be used as data, in connection with a knowledge of the drop in volts. The size of the trolley wire determines one size of copper to be used; the balance, in a sense, is put into the feeders. The entire problem differs but little in the case of central station or power-house, as regards the feeders. The rail drop in the case of the power-house, and the general line drop, in the case of the distributing system of a central station, are almost parallel cases. While a comparison is not necessary to serve the purpose held in view, it is just as well that it be understood by the reader, that feeders are an auxiliary part of every direct current distributing system, and in consequence represent a heavy item in the expense for equipment in copper. The volts drop per hundred amperes, if great mean power wasted; if low, mean money spent on copper. The choice that presents itself is, therefore, not only the usual one in such a case, but the fundamental one with regard to the expenditure for copper. The annual cost of power wasted in a special instance, may be one thousand dollars per annum in the case of a power line; the cost of the feeders to cut this expense down to five hundred dollars per annum may be ten thousand dollars. The financial proposition placed before the reader, therefore, is the choice of a fixed loss of one thousand dollars a year, due to wasted power, or a fixed loss of only five hundred dollars a year by means of an additional investment of ten thousand dollars. In the light of these facts, it is readily seen that ten thousand dollars more, yield an income of five hundred a year or ten per cent. This in a sense, is what led Lord Kelvin to issue his famous dictum, that: the annual cost of the power wasted should be equal to the interest on the investment generally considered. It is evident from this reference to a broader principle than is here applied or even indicated, that the financial development of a station is partly discovered in the manner and in the purpose represented by the copper. The equipment of a central station, with its elaborate feeding system, is neither more nor less than the layout of a financial system fundamentally, whose first investment is what is found in the grounds, real estate, machinery, and copper; and whose second investment is due to an increase in current consumption, and either appears in the form of new machinery to supply the extra load, or in the shape of additional feeders to reduce what would otherwise be a heavy loss in power. Feeders for power-houses and central stations are in this respect the making or the breaking of their success, and when so regarded assume an entirely different significance as part of the general scheme.

Fan Motor Engineering.

The fan motor is unique among engineering inventions, because of its place in the operation of modern establishments. It has a hygienic function to perform, so clearly defined, that no means that have been further invented, can be regarded as having infringed its own peculiar ground to any marked extent.

That it has solved a great problem and become in consequence, a fixed and reliable institution, in connection with all cases where either ventilation or its equivalent are required, is a matter of public knowledge. The incandescent lamp and the fan motor are, in a sense, what can be termed popular inventions; the fan motor more particularly so, in the eyes of the public, because of the large degree of immediate physical relief and comfort they obtain from it during the heated term. In addition to this, a fact that is not frequently pointed out, is that many stores and basements now utilized for business purposes, would be absolutely untenantable during the summer months, because of a stifling heat and insufficient ventilation, were it not for the means employed to drive a current of fresh air through, or otherwise keep the air in active circulation. In this respect, along crowded and therefore high renting thoroughfares, the electric fan, large or small, has been of aid in adding to the gross receipts from the leasing of valuable pieces of real estate.

What is called fan motor engineering, while really specialized into two departments called: fan motors proper and large ventilators electrically driven, has developed to such a remarkable extent, that it is now a distant and essential department in the design of many public buildings. In those edifices devoted to private enterprises of a large nature, such as the New York Stock Exchange, the problem of cooling, ventilating and heating, has been solved in a remarkable manner, as may be discovered by a visit to this establishment. But though this refers to the use of electric fans at least *twelve feet* in diameter, it is readily seen, that although one fan may be twelve inches and another twelve feet in size, the problems differ more in magnitude than in fundamental character. A fan driven by electricity is an electric fan, whether its blades be so bent as to exhaust the air in one direction and propel it forward in another or not. This, with respect solely to the direction of motion and the angle of the blades, is what determines the character of a fan; whether it is an exhaust or a pressure blower. The idea that should be conveyed in either case, is that a current of air is set into motion, either against a certain side of the fan or away from it.

That which has characterized fan motor engineering as a distinct department of the whole field of motor construction, is the fact that their design and winding was necessarily different from that of the larger power motors, because of the constancy of the load, and its uniformity. For this reason, fan motors of the twelve and fourteen inch fan type were wound to suit this state of affairs. A series wound motor will operate very successfully with a fixed load, or a varying load, provided there is always a load on the machine. The speed regulating switches, whether serving to commutate the field winding itself, or controlling the current supply by the use of resistance, are the generally accepted means employed to limit the current of air projected. What this system has meant in the majority of cases, aside from its technical significance, is best found in the opinions of restauranteurs, hotel keepers, and café proprietors from one standpoint, and the thousands who live in hotels and apartment houses in large cities from the other standpoint. One class, the former, look upon it as a business asset, indispensable at one season of the year; the other class, the latter, regard it as an element of luxury.

From the central station standpoint, the fan motor, large or small, has become a feature of the station load. It is not only pronounced in this respect, but has become increasingly so, with each new season. The prospects indicate so rapid a gain in the way of current consumption, on the part of private homes, that the near future will probably show a vastly greater station load, due to fans, than a superficial view would seem to show. The degree of technical perfection realized in the electric fan, combined with its cheapness and relatively high efficiency, can be well regarded as a triumph of engineering in this field. So simple a problem as the moving of the air for purposes of hygiene, has taken years to properly solve. Now that it has been done, the station manager can advocate the electric fan both loudly and widely.

The Evolution of the Socket.

The socket is one of the most essential and, therefore, the most firmly established, of all pieces of ap-

paratus used in electric lighting. But it must not be believed, particularly by the younger generation, that it was ever as good or as reliable as it is to-day. Neither would it be wise to regard it as having been as safe, from an insurance standpoint as it is to-day. These allusions to what it was, are entirely in keeping with the purposes implied by advanced invention in this field, if for no other reason than to show by contrast what it is at this writing.

Originally, the socket was a source of danger to the consumer of current, and unquestionably gave rise, directly and indirectly, to fires and shocks. A complete understanding of its relationship to not only electric lighting, but the places in which the electric light was used, did not seem to exist, to any marked extent, until attention was drawn to it by the fire insurance, as well as the electrical experts. who were present at its innovation.

The use of brass and wood as its elements of construction were noteworthy features not very many years ago. Receptacles were made of wood with brass contacts inside to meet the lamp base. Eventually a metal envelope or armor was used, and a wood or fiber body inside of a removable character. The important step forward was the use of a fiber body and an inner shell, to receive the lamp base. At the time that this improvement was in vogue, it was necessary to wrap the inner body, after the flexible cord or wires had been attached, with adhesive tape, to prevent contact between its metal parts and the outer shell.

The use of wood and brass in the socket in a general sense, represents the first stages of its use as a support for the incandescent lamp. The use of fiber and brass in the socket, may be regarded in the same light, as the second stage of its progress as a safe and substantial support for the incandescent lamp.

At present, on this basis, the use of brass and porcelain only, may be regarded as the third and most advanced stage in socket construction, not however strictly from the standpoint of construction, but from that of its elements of construction. It may not seem so at first glance, but the ultimate choice of non-combustible materials for sockets, and we might as well add, switches and switchboards, was really the result of thousands of experiments with unsuitable materials, as practice has proved to-day. Therefore, the porcelain body of the socket is to all intents and purposes, a permanent feature of its construction, simply because it is the last and apparently the best, as well as the cheapest, that can be utilized under existing conditions.

The striking feature about this evolution of the socket, however, is the permanence of the type of lamp base in general use throughout the country, and the effect this has had upon the type of socket that was thereby evolved. Looked upon from a mechanical as well as an electrical standpoint, the socket was no sinecure to design and construct. Simple as it seems, it taxed the brains of those who had devoted years of study and observation to its requirements. It was necessary to design it with reference to safety from fire, strength when assembled, simplicity in construction, cheapness, positiveness of action when in operation as a key socket, and durability when in use.

The development of the key from the keyless type of socket, meant the actual introduction of a switch in the device. It might be truly said in this respect, that the successful development of this idea, as embodied in the types on the market to-day, marks an epoch in the history of cheap, efficient and durable electrical appliances. To absolutely eliminate any possibility of contact between the outer shell, and the inner body with its connections, the shell is lined with fiber in both key and keyless types. In other words, the socket represents two distinct lines of thought: one, which might be called functional, because it relates only to its construction, as intended to serve a certain purpose; the other, which might be called protective, because it only relates to its construction and the selection of materials for the purpose of securing absolute protection from fire risks.

Along other lines the socket has been improved to serve special purposes, as for instance, its design to suit aesthetic tastes, or to perform the service of a light regulator, that is to say, a regulating socket. It is easy to understand the significance possessed by an apparently simple device like this, in so broad a field as that of electric lighting. In addition, it is not difficult to realize what a difficult road would have appeared before the investors in, and promoters of electric lighting, had the socket offered any insuperable constructive features that barred its use. In such a case the lamp would have had to be provided with a base or support in one. The consequence of this would have been a distinct change in the character of its application to electric lighting.

For these reasons, the rapid and general spread of electric lighting was engendered by the perfection of the socket, as well as by the perfection of the lamp and generating system. While it might be argued that the socket is only one of the many items in an electric light system, that add to its success, it may also be added that however successful the design and construction of generators for alternating and direct current work, and the stations and their systems of distribution still as far as lighting itself is concerned, the socket and lamp are just as fundamental. They are in reality one thing when together, though convenience and cost dictate their separation in manufacture.

Central stations are, therefore, dependent as much upon the degree of fine construction exhibited by the parts, which other than the building itself, constitute the real central station, as upon the order and system which prevails in their management. The perfection of each and every part in turn, places the burden more and more upon the management, and this it seems is what central station work is coming to. At one time many parts were inherently defective in principle and construction, the socket not the least of any. At present, these difficulties are being rapidly cleared away, and barring the personal element of management, central stations can be rated as good or bad, only as their appliances, which really constitute them, can be called good or bad.

CURRENT IDEAS

For Furnishing More Light, Heat and Power from Central Stations

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Organization and Conduct of a New Business Department Suitable for Central Stations in Cities of 50,000 Population and Under

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By John G. Learned

Perhaps most Central Station Managers are being advised or are seeking information relative to the organization of a new business department.

Assuming then that the Central Station is so equipped and in a position to furnish good service and regulation, with this support and backing a new business department is like a pitcher in a baseball game without fielding support.

The first question that enters into the organization of a new business department is, "Is it worth while to have such a department; under what conditions is it advisable to maintain such a department?" The size of the company and the size of the town in which they are doing business are important factors in deciding whether or not it will be justifiable to establish a new business department. Granting that the business of the company has developed to such an extent that the necessity of a department for securing of new business is obvious, the writer will therefore proceed to give you such information relative to the organization and conduct of a new business department, hereafter called the Contract Department.

The points set forth are those which have been actually put in successful practice. Every one readily agrees that no matter how small or how large a district a Central Station is operating in, it requires someone to care for the old and new business. This is very often taken care of by the manager or his assistants until as mentioned the management of the company feels the necessity of having their contract work superintended exclusively by a specialist.

We now have arrived at a point where it is absolutely necessary to secure the service of an able contract man to have exclusive charge of all work incident and relative to the securing of new business and increase the Central Station load. The solicitors should be appointed and report directly to him, so also should the construction department, meter department and advertising department, in fact all other departments must of necessity be subservient and work in conjunction with the contract

department. Before going further it should be impressed upon all members of this department that the most liberal policy should be used in its conduct. The contract agent is most successful who is a judge of human nature and who is able to select as his assistants men of strong personality, capable of becoming friends of the public. The individuality of the agent counts a bit in the amount of business secured. This contract department must of necessity consist of able and apt salesmen. The writer considers salesmanship an art and a science which should be thoroughly studied. For the agent to be successful he should make it his profession, as it is truly a profession. If the Central Station company does not have the talent to thoroughly instruct members of the contract department in this art of salesmanship, it may be readily acquired from several schools who make a specialty of salesmanship. The number of solicitors required depends upon the size of town or city in which you are operating. Would suggest, however, that there be one solicitor for every 15,000 inhabitants. Impress upon all your solicitors the absolute necessity of *hustling* morning, noon, and night. Have them establish confidence in the public, and at all times the motto of the contract department, and in fact the motto of the company, should be "A square deal to the public." Each and every solicitor, in fact, every member of the company, should talk electricity at all times. The enthusiasm of the contract department should be at white heat always. Various methods have been tried with varying success. Conditions in each place are so entirely different that the writer will not attempt to formulate any scheme for promoting enthusiasm. Experience has taught us that in order to get the best result it is a matter of dollars and cents, therefore pay your agents a salary and a very liberal commission on business secured and connected to the service. By doing this you will find that the results obtained are far more satisfactory than if you paid a straight salary. Every member of the contract department must of necessity be a consistent, insistent and persistent plugger. Talk electricity day and night and do not overlook the fact that the small consumers need as much attention, and in fact some cases more attention, than the large consumers or prospects. It is surprising to learn of the large amount of business which may be secured in out of way places, therefore do not overlook the alleys and back streets in soliciting.

Courtesy, especially telephone courtesy, must be thoroughly installed in the minds of the members of the department and should be the watchword of the company.

It is not the intention of the writer to go into the details and systems incident to running the office end of the contract department, only to put before you schemes and methods for obtaining new business which have not met with varying success in different localities. A proposition may fall flat in one district, while in another it might have been eminently successful. Try a few and suit yourself, in any event be satisfied with the results obtained. If not successful in one place try it over again in another section. Before going further I wish to state that the duty of the contract department is to make everything electrical, not to overlook any prospect. It must create a demand for the commodity of the Central Station because, as we all know, juice must be treated as any other item of commerce. We are here to sell it, promote its uses, create a demand for it, compel the unwilling to learn of its comfort, convenience and power. Inasmuch as we are here to teach the public its uses, less talk and more work is required. Office systems are a grand thing, in fact, systems of all kinds are, however, business cannot be secured sitting in the office, especially lighting and power business. Results are what we are after, therefore we must be up and out after the business early and late.

The first duty of a solicitor after having been assigned a town or district, is to make a thorough canvass of the territory for residence, store, sign factory and power customers. The prospects obtained are to be placed on file in the central office and are to be placed on cards especially provided for that purpose. By maintaining this card file of the prospects considerable time is saved and helps the agents with all that which is going on in the district. Too much familiarity with the list of prospective customers does not breed contempt. Contrary to this will say that it does promote new business and that is what we desire. A large majority of the Central Stations operating in towns with a population of 50,000 or under have a great proportion of residences as prospective customers, therefore it seems that it is most fitting to take up the subject of securing residence business, and later store sign, factory and power business.

Assuming that the Central Station, and this is a natural assumption, has obtained the cream of the business, or that business which did seek the

service, it is not often necessary to solicit business, owing to the fact that the natural increase is decidedly small with the average Central Station. It is absolutely necessary at times that the Central Station should maintain a wiring department, and also should encourage private local parties in the wiring business as the results are manifested. The more competition you have in the wiring business, the quicker your load will grow. If necessary, throw a few wiring jobs to the local man. It pays. Induce the man selling appliances to visit your territory. This also pays. If feasible, get all and any firms handling reliable electrical appliances to solicit in your community. They are all working indirectly for the Central Station company. The connected load is increased, the income is increased. You are selling current, let the other fellow sell the appliances. The current revenue is perpetual.

We all do know that the resident hesitates to have his home torn up, as he thinks it will be, and sometimes is, in order to install electric lighting wiring and fixtures. Again, the expense prevents him from taking this step (to comfort and convenience). Give the resident prospect a cost estimate for wiring his place. We find that by offering to put in the wiring and fixtures at cost on monthly installments, we have secured a very large number of old houses which, if it were not for this proposition, would still be using antiquated methods of illumination. Right here will say that it is the old residences that need the most attention. The new ones will, as a matter of course, take care of themselves. It is a very easy matter to induce a man building a new home to have it wired.

Experience has taught us that wiring for a porch light at cost has been the means of securing on our service a very large number of customers. Sixty customers were secured out of 275 people approached by a circular letter. This you will admit is a very large percentage. The cost of burning a porch light is nominal and rarely runs over 75 cents or $1.00 per month. At first sight you may think it does not pay to put in service for one lamp. It does. It is only a short time before the entire house or part of it is wired.

The next proposition for old residences is to wire for six outlets at a concessional price of one-half of the actual cost, the outlets mentioned to be placed as per direction of the consumer, with restrictions according to the conditions existing in your particular locality. Six outlets will give the customer a chance to try the light and invariably result in putting on additional lights. This proposition was offered to about 600 old residents, out of which 53 responded and 23 were secured to the service. This is considered a small percentage.

The average man is always ready to accept something which apparently is free, therefore for a period of three months make a standing offer to allow $25.00 worth of current free to any resident who wires his home for a certain number of lights during that period, said free current to be used within a specified time. The results from this offer were very gratifying, in fact, flattering, as about 40 old houses which before making the offer were almost impossible to reach, readily came on the service.

The following very attractive proposition was offered to a selected list of about 200 residents who occupied their own homes. (Circular letter sent to above mentioned selected list):

"To the residents of your section who own their own homes, and who have considerable investment in them, we are making the following very attractive offer:

"We will bring our lines to your premises, install our service, and at your direction wire for not to exceed six single electric light outlets, entirely free of cost.

"We would suggest a light for the porch, controlled by a switch in the vestibule; one in the library for a reading lamp; one in that *dark clothes closet* will eliminate all possible danger of *fire,* and one in the furnace room controlled by a switch at the head of the stairs.

"All we wish is that you agree to use electricity for burning the lamps for two years, and that your monthly bill be at least one dollar.

"It is our intention to make but *ONE HUNDRED* of these installations, and the first one hundred applications we receive will obtain this wiring free of cost. This involves an expenditure of a very considerable amount of money on our part, and if at any time you conclude to equip your premises throughout for the use of electric light, it will make a very material saving in the expense.

"The enclosed postal card with your name and address, mailed to us, will bring our representative, who will be pleased to give you full information on the subject."

Seventy responded to this letter, and as a result

the Central Station was successful in securing 47 old residences, all of which are considered very good customers. Their bills average about $3.50 per month, this average taken for a period of eight months. The average cost of wiring each of the above houses mentioned was about $20.00.

The foregoing are a few of the schemes which have been used with success in obtaining old houses on the system. A new proposition will always bring in a few of the old residences.

Most towns have a few tenement and flat buildings. It is sometimes a task to obtain the lighting of these buildings. It is a good policy to have them wired at any cost, having the halls wired separately from the flats; this being done in the first place, the rest is easy. As a rule, tenants in flat buildings are very good customers, easy to secure and easier to hold. In order to permanently secure and hold the hall lighting, the Central Station shall allow the owner a special commission in the form of a discount on his hall lighting, this discount depending upon the number of customers in the building which use the Central Station service. As a result of this proposition the owner or agent of the building are instrumental in having a backward tenant use light. This proposition also applies to office buildings. Right here will say that it is important for the district solicitor to win the heart of the janitor of the building, as he is of great value to the Central Station in securing flat customers, as he is on the ground with the prospective customer at all times, and a word from him goes a long way in convincing the prospect that he should use electric light.

The problem of securing store business we are ready and willing to admit is a very difficult one. Many schemes and methods have been tried. The writer suggests, however, that to start the wayward store customer using electric light by first getting him interested in lighting his windows.

To him window lighting is a matter of experiment. In order to show him that it is not an experiment with you, but an absolute necessity, and that you have confidence in the fact that he will continue to use electric service, wire his windows free of charge. You may hesitate to do this. Don't. It is good business. It is not only an advertisement for the storekeeper, it is also the best advertisement the Central Station can obtain. The income is good, as a storekeeper as a rule is a long hour user. Induce him to use the light in his windows when he has closed the store. In order to sell goods you must show them, and show them under the most favorable conditions. This may be done by using electric light. Teach him the why and how, how to light windows, and why, because it is his best advertisement. Impress upon him the necessity of showing his goods and show them as before mentioned, under the most favorable conditions. Space will not permit giving an illustration of the modern methods of window lighting. Some differ. The writer considers trough reflector window lighting the most advantageous. The lighting of the interior of the store follows as a natural result. Each and every place requires special attention.

In those districts where you find that it will pay to maintain patrol service, install arc lamps on a flat rate basis. Furnish the standard arc lamps, do the wiring, both for flat rate service and also on meter basis; on meter basis with a special minimum monthly guaranteed. Experience has taught us that arc lamps are most satisfactory for space lighting and that a large amount of well paying business has been secured by doing free wiring. Special attention should be given to the distribution and maintenance of arc lamps.

One branch of the electric lighting business too often neglected is signs. Do not hesitate pushing it. It means big revenue and is a good advertisement Start out right. Hang a sign in front of your office, also one or two in another portion of the town to advertise your business. If you show the public that you believe in signs they will follow suit and you will find that the sign business will grow. Adopt a standard sign.

There are several companies that now make a specialty of furnishing Central Station companies signs at a reasonable price, which may be used time and time again. Signs furnished free to the customer have been the means of securing a vast amount of business. By free, the writer means that the signs are furnished, hung and connected without expense to the consumer, under a special contract whereby he agrees to use a certain amount of current each month. If patrol service is convenient, furnish the sign on patrol basis, if not, on meter basis.

The factory lighting business depends entirely upon local conditions and the price of the current. Constant soliciting will secure this business where light is used at all. It should be the ambition of every Central Station manager to run day service, provided he can see his way clear to make it pay.

It is admitted that in some cases it would not pay, but assuming that the Central Station is operating in a town having a number of small factories, the Central Station manager should not hesitate to furnish day service. In order to make it pay a power load is necessary. Time and space will not permit giving the minute details necessary to building up a power load, only will say, put a competent, ceaseless worker in the field to thoroughly canvass the entire community. It is often surprising to learn of obscure places power service may be installed. Sell motors at cost or as near cost as possible. Sell them on time. If possible, rent them. Place a motor in on trial, in fact, do anything and everything to obtain the consent of the consumer to take power service. The writer does not know of one case in which the service was removed on account of the inefficiency thereof. Convince the customer that electricity is the proper and only power for him.

The time has now arrived when the Central Station should be active in placing electric appliances among its current consuming devices. The electric flatiron seems to take best because it is an article which is in general use. There are several methods of placing them with the customer. Thirty days seems to give best satisfaction. Recently in a small community 37 irons were placed out on 30 days free trial and only two were returned. These small appliances are mostly used during the day. The income received from an ordinary flat iron is from $5.00 to $9.00 per year, therefore, it seems advisable to sell appliances at as near cost as possible. The following is a circular letter sent to a few customers, return postals being enclosed:

"You use electricity for lighting because you know its many advantages, but you do not use it in all the comfortable ways you could or should. We have at least a dozen inexpensive appliances that should be in every household. They add to your comfort and convenience. You have really no idea how much until you have actually used them.

"I should like the privilege of sending to your home for your inspection any of our household electric appliances. First, I wish to send you a standard six pound flat iron on trial. Try it for thirty days and if it does not suit you return it. You are under no obligation to buy. This is the only way to prove to you the extreme convenience, simplicity, and economy of this up-to-date household necessity.

"Use the enclosed postal card, saying when I shall send you one. You will be under no obligation to do anything more than look at it, and should you think you do not wish to keep it (for a trial) we will return it without argument."

Another good scheme is to have a young lady call at the premises of the consumer and demonstrate the various electric appliances which you carry. Make it easy for the customer to secure the various articles. It is marvelous to think of the attempts some of the Central Station companies make in the advertising line in order to secure new business. Most of the small companies are inactive in the advertising field. Why they should remain dormant in this line is a mystery. Look around you, Mr. Central Station Manager. All the department stores and merchants are awake, up and doing. Perhaps you sit idly thinking that business will come to you. This should not be done. You are selling a commodity similar to that of your neighbor. Put it before the public, show it to them, keep it in sight of the public all the time. The question is, how to impress upon them the fact that you are doing business. There are many methods of doing this. First and easiest will be in using the newspaper as an advertising medium. Secure a small space in a local paper. Change your advertisement periodically. Tell the public in a clean, clear and concise way of your business. Each advertisement to be a story, not too long, and should bring out a new point each time relative to the advantages obtained in using your service. As a rule the newspapers are always ready and willing to accept copy. Why not make it electrical, readable, interesting, in the form of a story, telling the uses and advantages of electricity. Should any Central Station manager desire copy of the matter used by the writer in this manner, same will be gladly forthcoming upon application.

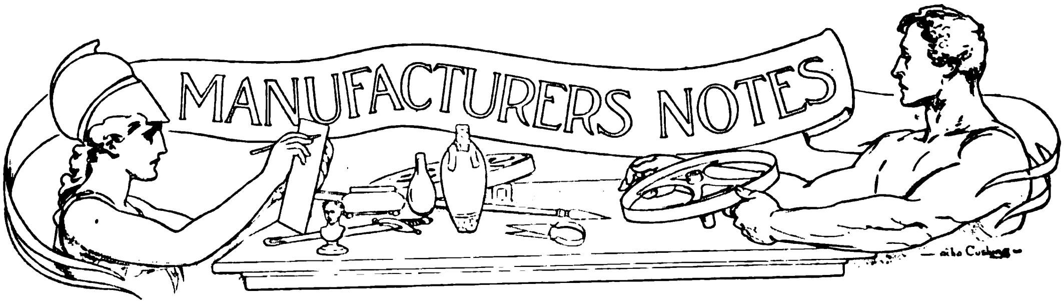
In most towns there are a few drug stores. Advertising through the medium of a drug store seems to be most profitable, as every class will at one time or another call and make purchases at a drug store. Would suggest that an advertising cabinet 30 by 50 inches be placed in each drug store. Over the top of this cabinet place an incandescent lamp with a globe on it inscribed "Use electric light and power," the cabinet to be provided with a glass door. In back of the glass door insert advertising matter periodically. The rent for space for this cabinet may be allowed in the form of a discount on the druggist's light bill. Said cabinet to contain

pockets for advertising matter which is distributed by the Central Station company. The only actual outlay of money in this advertising is the cost of the cabinet and the advertising matter you insert in it. A special agreement being made with the druggist to turn the light on the cabinet, on and off.

There are several companies now in the field prepared to furnish the Central Station company with a complete advertising by mail campaign, consisting of thoroughly modern and well worded folders, postal cards, bulletins, facsimile letters, etc., which are to be sent to the prospective customer not less than twice a month. In this way you keep him thoroughly alive to the fact that electricity is what he should use for lighting, power and heating purposes. As soon as the prospective is signed up take him off the mailing list. Too much stress cannot be laid upon the necessity of keeping your commodity before the public at all times. The conditions existing in each community suggest methods of publicity. Do not lag; be persistent, consistent and insistent in your advertising methods. The Central Station company can readily afford to spend from 2 to 6 per cent. of its gross income for advertising purposes.

All of the preceding has been given under the assumption that the Central Station has established a fair and equitable rate for light and power. The writer considers that from 10 to 15 cents per K. W. H. for residence and store lighting, and from 5 to 10 cents per K. W. H. for power service is a reasonable rate. The rate of course depends entirely upon the locality in which the Central Station is doing business. It is of the utmost importance that you give each and every customer the proper attention and treatment after he is on your service. Experience has taught us that it sometimes takes a better man and argument to hold a customer than to secure him in the first instance.

In conclusion will again say, that systems are fine, but they do not get the business, and business is what we are after. Have all employees of the contract department up, out and doing, aggressive at all times, courteous beyond criticism. At all times inspire confidence in the public. Confidence signs contracts, and signed contracts are what we are after. In order to impress it upon you, I again repeat that the motto of the Central Station company should at all times be "A square deal to the public."



G. E. Fan Motors for 1907.

Fan motors have reached a place where they are perennially useful. Not only are they now available for cooling purposes in summer, but they may be used to augment the heating during the colder months, as well as to supply air in motion for dozens of other interesting purposes. When the central station man sells a fan motor, to-day, it becomes, with a few judicious hints, not the least valuable of revenue getters.

The General Electric Company makes a complete line of fan motors which can be advantageously introduced as business getters during both summer and winter. Desk fans as usual are furnished in all different types for standard voltages and frequencies

or can be wound special to order. Both direct and alternating current fans of the desk type can be ob-

G. E. DESK TYPE, ALTERNATING CURRENT.

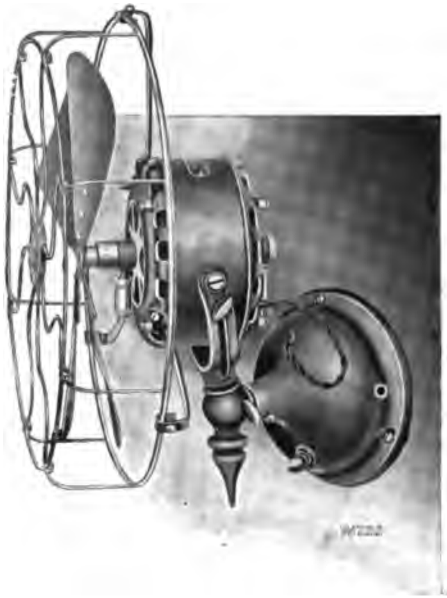
tained with 12 or 16 inch blades. These with the bracket type of the same design and sizes are avail-

G. E. DESK TYPE, DIRECT CURRENT.

able for all classes of service. In addition to the ordinary uses for cooling, office desk or domestic ventilation during the summer months they will keep the frost from the storekeeper's window or supply air currents for advertising novelties of various kinds.

In a store on a windy street an odd use of a fan of the desk type was recently noticed. The customer's entrance to the shop was accompanied by a stiff breeze which badly disarranged the nearby counters. A large fan motor was mounted opposite the door so that the force of the air counteracted the entering breeze, the door by this method being opened in comparative calm.

Combining the compact and efficient general design of the desk and wall bracket types of fan mo-



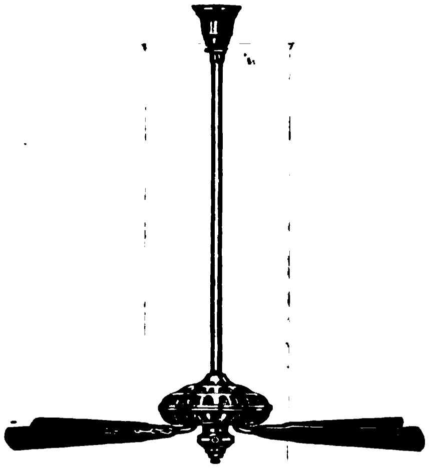
G. E. WALL BRACKET TYPE A. C.

tors, with special mountings are the telephone booth ventilating fans and the exhaust fans. The spring

G. E. TELEPHONE BOOTH TYPE, HUNG ON SPRINGS TO ABSORB VIBRATION.

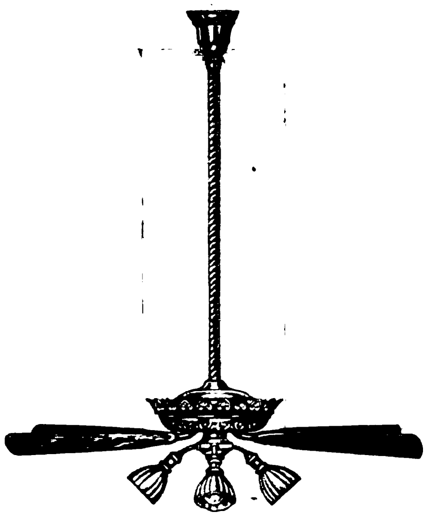
suspension of the former eliminates vibration in the telephone booth and makes what is ordinarily a

Turkish-bath cabinet more bearable in summer. The General Electric Company can furnish eight-inch telephone booth fans for both alternating and di-



G. E. CEILING TYPE.

rect current at commercial voltages and frequencies. The illustrations of the exhaust fans indicate the method of mounting these. This type of fan is

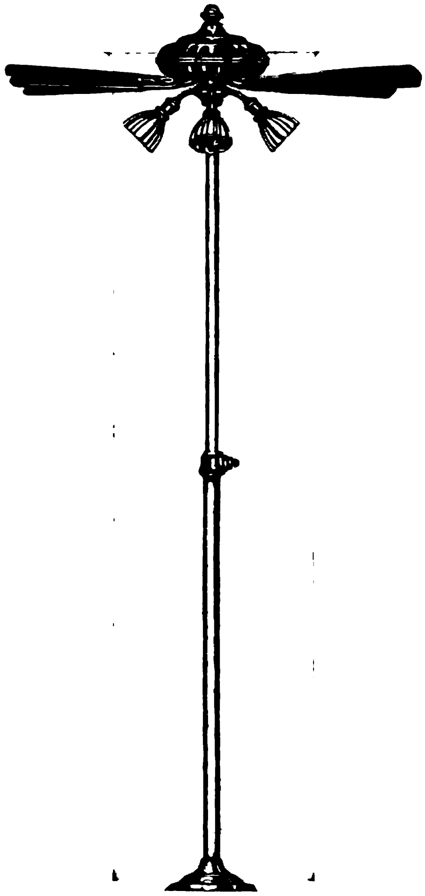


G. E. CEILING TYPE WITH ELECTROLIER.

useful in both private and public kitchens, in restaurants, lavatories, and stores where a permanent method of ventilation is desirable.

Quite recently the use of the fan motor in the cold-air pipe of the hot-air furnace has been exploited, and an economical addition to this heating system. The square frames of the exhaust fan types might readily be adopted for this purpose and a permanent installation be made.

Ceiling types of fans are illustrated. The broad wooden blades of this type of fan suit them especially for the cooling of large areas without disagreeable drafts. The fan blades are 52 inches in



G. E. COLUMN TYPE WITH ELECTROLIER.

diameter for alternating current fans and 56 and 58 inches in diameter for the direct current motors. All have four blades and can be obtained in plain or in ornamental designs. The alternating current ceiling fans have two or three speeds, while the 58-inch blade direct current fan can be operated at 3 speeds and the 56-inch blade direct current fan, at a single speed. The motors are wound for all commercial voltages and frequencies.

For soda-fountains, public dining-tables, etc., a combination column fan and electrolier forms an ar-

tistic fixture. Such a fan is illustrated. The motor is designed for alternating current and a 52-inch, four blade fan is used.

Fan motor design has come to be more or less standard, but certain principles are involved in all these fan motors made by the General Electric Company. Both direct and alternating current fans have special blade design, a positive trunnion adjustment and liberal lubrication. The latter is so made that oil throwing is impossible.

The fan blades are designed to distribute the air at a wide angle, and not deliver it in a straight column, covering a limited area. Disagreeable humming has been eliminated by carefully balancing and hanging the blades.

Mention has been made of various speeds of fans. This speed variation, in alternating current motors, is obtained by a six-point reactive coil and switch. In this way the G. E. standard desk or wall bracket type is of well-nigh universal application, since it may be operated on slow speeds for the office desk or home, and on the higher speeds for stores and halls. Similar speed regulation is obtained in the direct current type of desk and wall bracket fans by a self-contained four-point switch and indestructible resistance, giving three speeds.

All the various types of fan motors which have been mentioned are to be obtained in standard commercial sizes, and for any commercial voltage and frequency. Special windings for operation on odd voltages for frequencies can also be furnished to order if desired. In general the standard finish for G. E. fan motors is black with brass trimmings, but this, too, may be varied to meet special conditions, and fans can be decorated to match office fittings or to harmonize with the hardware in private dwellings.

A Popular and Successful Line of Electric Fans.

The two essentials in a successful fan are, large breeze producing capacity and a low current consumption. To combine these two features without favoring one at the expense of the other, requires the nicest engineering judgment. To any casual investigator it would soon become evident that, aside from the driving motor itself, the mechanical features upon which both the breeze producing capacity, and the low current consumption of a fan most depended, were the shape and curvature of the blades and the angle at which they presented their surfaces to the atmosphere. In their 1907 model fans, the Westinghouse Company has developed these features of electric fan construction to the highest degree. The curvature of the blades is such

WESTINGHOUSE DESK TYPE.

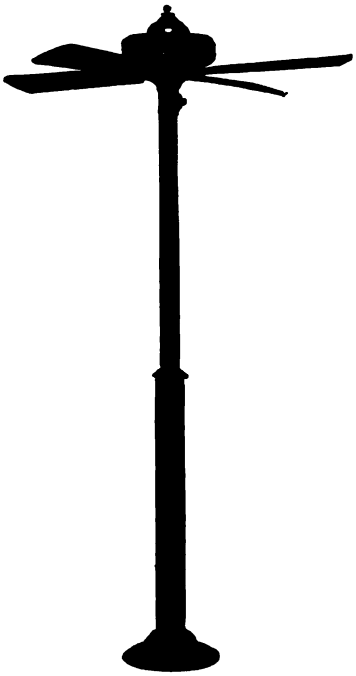
as to project the air in a diverging direction and with equal force from the whole surface of the revolving fan. With most other fans the air forms a whirling cone a few feet from their surfaces. The angle at which the blades of Westinghouse fans are firmly set, throws off the air but does not churn it, to this feature the economical effectiveness of these fans is largely due. It is obvious that the more power required to drive the fan blades, the more current will be consumed; with this point in view the angle at which the blades of these fans are adjusted

WESTINGHOUSE WALL BRACKET TYPE.

is such, as to give the maximum volume of air consistent with the least resistance against the blades, making the demand upon the motor the lowest and consequently involving an equally low current consumption. In fact a 12-inch Westinghouse fan at

full speed consumes less current than a 16-c.p. incandescent lamp.

Westinghouse fans are made for both alternating



WESTINGHOUSE FLOOR OR COUNTER TYPE.

and direct-current circuits, and embody every feature which experience has found convenient. An adapter allows a desk fan to be changed to a wall bracket type without disturbing the connections, and *vice versa*. The different models include all styles; desk, wall, ceiling, floor, column and counter types.

Regarding the motors themselves, which drive the fan blades, it is only necessary to say that they are thoroughly Westinghouse throughout, requiring no more attention, and no more knowledge to operate than an incandescent light. We give below a part synopsis of the sizes and operating characteristics of Westinghouse fans:

DESK TYPES.

For A. C. Circuits.

Twelve-inch fans for 100-120 or 200-230 volt circuits of 25 to 30, 40 to 50, 60 and 133 cycle frequencies.

Sixteen-inch fans for 100-120 or 200-230 volt circuits of 25 to 30, 40 to 50, 60 to 133 cycle frequencies.

For D. C. Circuits.

Twelve-inch fans for 100-115 or 200-230 volt circuits.

Sixteen-inch fans for 100-115 or 200-230 volt circuits.

WALL BRACKET TYPE.

All styles of desk fans are readily convertible into this type by use of a simple adapter. The fan base is provided with screw holes for mounting on wall and no change in wiring of fan is required with the use of the adapter.

CEILING TYPE.

For A. C. Circuits.

Fifty-seven-inch fans for circuits of 110-115 or 200-230 volts and frequencies of 40 to 60 cycles.

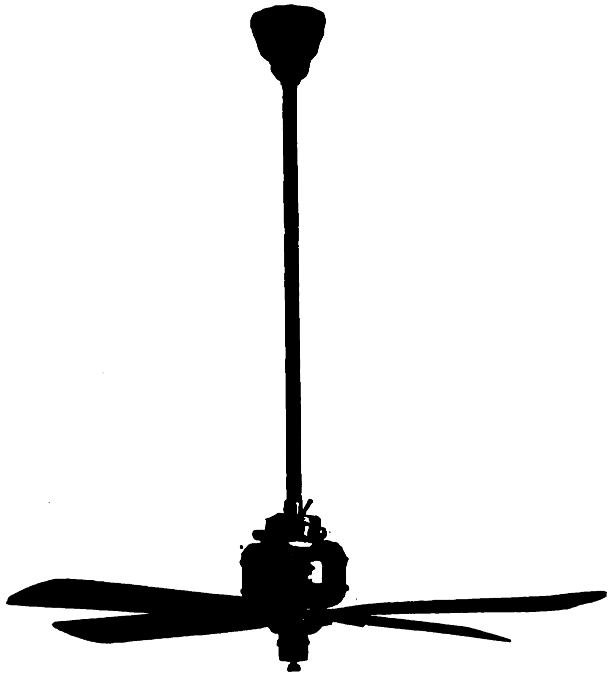
For D. C. Circuits.

Fifty-seven-inch fans for circuits of 100-115 or 200-230 volts.

FLOOR COLUMN TYPE.

For A. C. Circuits.

Fifty-seven-inch fans for circuits of 100-115 or 200-230 volts and frequencies of 40 to 60 cycles.



WESTINGHOUSE CEILING TYPE.

For D. C. Circuits.

Fifty-seven-inch fans for circuits of 100-115 or 200-230 volts.

COUNTER COLUMN TYPE.

For A. C. Circuits.

Fifty-seven-inch fans for circuits of 100-115 or 200-230 volts and frequencies of 40 to 60 cycles.

For D. C. Circuits.

Fifty-seven-inch fans for circuits of 110-115 or 200-230 volts.

The Westinghouse Company has for distribution some very attractive booklets describing their different fans. You can get them from most any supply dealer, or by addressing the company.

The B-H Time Switch.

It has been said that "Necessity is the mother of invention." The demand for a *reliable* time switch has caused many to attempt to produce one. Long and practical experience has taught that there are certain essential features that must be embodied in a machine of this kind. Fundamentally *there must be reliability, accuracy, simplicity,* and last, but not least, *practicability.* The selling price *must be taken into consideration* and not made so high as to eliminate its economical benefits. The conveniences, benefits and assistance to central stations in procuring the most desirable contracts are quite generally understood. By desirable contracts we mean contracts that do not terminate when the peak load has been reached, like signs and show window lighting. It has never been disputed that it is much easier to secure these kind of contracts on a flat rate than with a meter rate, and the *reliable* time switch allows this to be done by protecting both the central station and its customer, and also makes a meter unnecessary.

Reliability and *accuracy* can not be secured without a proper time piece; this means that when a time switch is to be used in all kinds of places with all sorts of climatic changes, that *special attention* must be given to these facts and that a time piece must not be expected to furnish power for a switch mechanism and keep *accurate time.*

A careful search, long study, experimenting with all kinds and makes of clocks, together with the opinions of many of the best clock experts forces one to the conclusion that there is *no standard clock made* that can be depended upon to always give the proper results for a time switch. All these facts were kept firmly in mind in producing the B-H Time Switch, its clock having special features embodied in no other time piece and its switch mechanism being operated by the most reliable force known —*Gravity.* That the B-H Time Switch has overcome all obstacles is well demonstrated by the fact that one user alone installed over 600 B-H Time Switches in the last twenty months.

The switch mechanism is operated solely by gravity, *the only reliable force on earth,* and entirely eliminates the many objections to gears and springs which are oft-times affected by extremes in temperature. The clock is strongly yet simply built and has a special starting device that allows a hood to thoroughly enclose and protect the balance wheel and hair spring, the most delicate parts of a clock; it also has a specially constructed hair spring that is practically impervious to moisture, not a phosphor bronze hair spring, however, as these have long since been discarded, as they are not practical. The

THE B-H TIME SWITCH.

B-H Clock is so constructed that it will withstand extreme climatic changes. The clock requires winding only once a week and is mounted at the right hand end of a porcelain base. On the left hand end of the base, standing four square, are the steel cups. These cups are carefully insulated and contain mercury for transmitting the current; on top of the mercury is a quantity of oil, making it positively non-arching. Each cup is secured to the base by a brass screw which is threaded into the bottom of the cup and goes through the porcelain base, a nut on the under side making it rigid. This

screw projects below the nut to which is secured the terminal for attaching the service wire.

The drop wires which hang pendant above the mercury cups whose simultaneous lowering and raising closes and opens the circuit, are thoroughly insulated on their exposed parts.

The clock has a dial that makes one revolution every twenty-four hours and has two pointers on its face that are secured to its center by a thumb nut. Attached to the clock and directly under the dial, is a star wheel of six points. Attached to this wheel and on the same shaft, are two three-pointed cams. Each of these cams operates a lever, one to drop the wires into the mercury and the other to raise them, its action being instantaneous. The whole switch is compactly constructed and easy of access to all its parts and its operation is positive yet gentle.

The case is of galvanized iron, the outside dimensions of which are 13 3-16 inches high, 8 1-8 inches wide, and 4 1-2 inches deep. The door is fitted with a rubber gasket, making the case both dust and weatherproof. The case has two compartments, the upper one for the clock and switch mechanism, the lower being fitted with porcelain bushings for the service wires, with plenty of room for making the necessary connections.

A cut-out attachment which renders the machine inoperative on Sundays or other desired days, and which does not complicate the machine in any way, can be furnished when desired.

Helios Flaming Arc Lamps.

The main structure of the new Helios flaming arc lamp, manufactured by The Helios Manufacturing Co., of Philadelphia, consists of a heavy brass tube connecting the lower brass plate with the top casting and to which is secured a casting which supports the resistance spools and the carbon holder guides. Inside of the main tube is a rod operated by a magnet in the top of the lamp which is energized when the current is thrown on, draws the rod upward and thus by means of a presser foot at the lower end of the rod, separates the carbons and strikes the arc.

The blowing magnets shown in the illustration as well as the plunger magnet, are wound with asbestos insulated wire. The flexible cables leading to the carbon holders are insulated with glass beads. The resistance spools are our well-known grooved porcelain spools in the grooves of which is wound the resistance wire.

It will be noted that there are no clutches, chains, gears, nor shunt winding in this lamp. It feeds entirely by gravity and the bridge connecting the carbon holders, which is clearly shown in the illustration, insures equal feeding of the two carbons. Substantial binding posts are provided. The cases are made of either brass or bronze in any desired finish, and being waterproof, can be used either in or out doors. A special shaped globe is so designed that the light rays will pass through it nearly at

THE HELIOS FLAMING ARC LAMP.

right angles. In other words, the shape of the globe is practically the shape of the arc itself.

As these lamps require only forty volts at the arc, it is possible to operate two of these lamps in series on 110 volts, and when so operated and adjusted for a current consumption of ten amperes, they have an efficiency of .25 watt per mean hemispherical candle-power. The distribution of light from the flaming arc lamp is very much superior to the distribution of light from any other type of arc lamp and particularly with a lamp such as the Helios on account of the absence of all obstructions below the arc. Two of these lamps will give as much actual light as six enclosed type arc lamps and will consume

only one-third the amount of current. The light is of a most pleasing appearance and while lamps of this type have so far been little used except for outdoor illumination, still they are just as well adapted to indoor illumination, particularly in railroad stations, ferry houses, foundries, machine shops and other places of that character, especially if there be any steam or smoke present because the reddish rays from the flame lamp are more penetrating than the rays from lamps of other types. This makes the lamp very desirable for railroad stations, steel mills, foundries and the like.

All the metal parts, other than the top casting and the case, are nickle plated. The case can be furnished in any desired finish.

The lamp will burn equally as well as when operated four in series on 220 volts as when connected two in series on 110 volts, and by the addition of two resistance spools, for which provision is made in every lamp, they can be adapted for single burning on 110 volts, or two in series on 220 volts. The maximum efficiency is secured when the lamps are connected two in series on 110 volts or four in series on 220 volts. However, there is no necessity for doing this as a single lamp burning on 110 volts adjusted to take six amperes will give twice as much light as any five ampere enclosed arc lamp.

All parts of these lamps are built to standard gauge and are positively interchangeable. The resistance is self-contained, and, although the carbons are 400 mm. long, the entire length of the lamp from the top of the hanger eye to the bottom of the globe is only 30 inches and the weight but 25 pounds complete.

Holophane Reflector-Stalactites.

The Holophane Company, Sales Department, have recently placed on the market a new reflector-stalactite similar in construction and application to their well-known Pagoda ball which has been used so largely in the public buildings of this country.

Fig. 1 shows one of these reflector-stalactites, the upper part consisting of scientific prisms while the lower part is of ground glass, the whole being made in one piece, thereby uniting the effects of the frosted glass with the efficiency of Holophane prisms. This globe is made for a 3¼ inch holder, has a width of 6 inches and a height of 7¾ inches.

Fig. 2 shows a similar type of reflector-stalactite having exactly the same dimensions in regard to holder and width but having a height of 10 inches.

The globes in point of efficiency easily achieve the

FIG. 1.

high standard set by the Holophane system. When lighted up, the result is very brilliant and altogether adds greatly to the artistic features of any place where used. The ground glass bottoms of these stal-

FIG. 2.

actites can be cut in a number of different patterns. In this way the beauties of cut glass are combined with the Holophane system of illumination. Lamps of from 16 c.p. to 22 c.p. are recommended for use in these globes.

Full particulars and prices may be had by writing

to The Holophane Company, Sales Department, 227 Fulton street, N. Y.

The Warren Electrical Manufacturing Company, Sandusky, Ohio, have purchased the plant and good will of The Warren Electric Manufacturing Company of this city, and in addition to manufacturing the well-known "Warren Alternator" will manufacture a full line of revolving field type generators, also A. C. and D. C. motors, transformers, etc.

The officers of the new company will be Millard H. Nason, president, who is also president of The Brilliant Electric Co., Cleveland, Ohio; Frank Warren, secretary, who has been secretary of the Warren Electric Mfg. Co., for a term of years, and Norman L. Hayden, general manager, who was president of the Hayden & Derby Mfg. Co., New York City, for a term of years, and for the past five years general manager of the N. L. Hayden Mfg. Co., Columbus, Ohio.

The Trumbull Electric Mfg. Co., of Plainville, Conn., state that before long they are to publish

TRUMBULL TYPE A KNIFE SWITCH.

their new catalog which is to have the "precarious" distinction of showing the most complete line of switches ever published, requiring forty catalog pages.

Trumbull's further announcement that about 45,000 *separate switches* are to be priced in this new catalog does not stagger the unsusceptible mind so much when it is considered that every possible combination is to appear; front and back connected, quick break, double break, quick break and double break, fused and unfused, plain and polished, D C and A C,—110, 250, 440 and 600 volts ranging from 15 to 2,500 amperes and covering in their respective classes, both Type A (as shown in cut) and Type C switches. In fact, there is no knife switch which they cannot supply.

Dunton & Field, 117 Main street, Cambridge, Mass., manufacturers of the Dunton tree insulator, are meeting with great success with these insulators among the electric lighting and power stations all over the country. Over two thousand of these insulators have been sold since February 1.

The Edison Electric Illuminating Co., of Boston, has recently ordered thirteen hundred, with which they are equipping all their lines in the outlying districts of Boston.

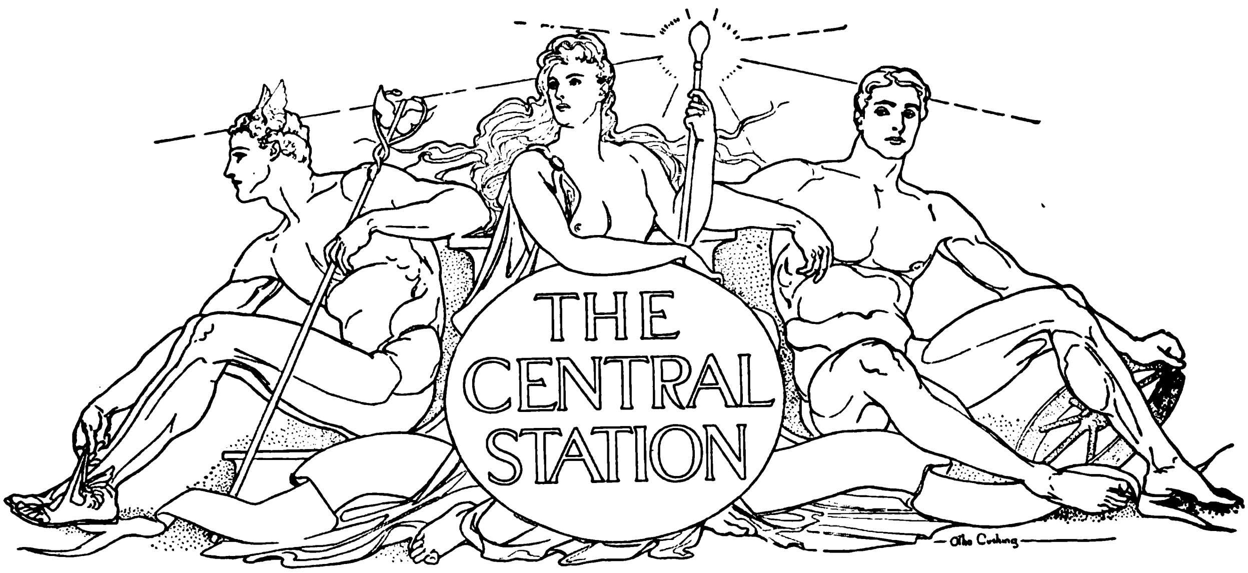
John Wiley and Sons, publishers, 43 and 45 East 19th street, New York City, have just brought out a new revised and enlarged edition of "Electrical Engineering," a practical treatise for the practical central station man, by Mr. E. Rosenberg, chief electrical engineer for Körting Brothers, of Hanover, Germany.

This new edition consists of 360 pages and 333 illustrations and diagrams, and has been brought down to date for American practice by Mr. Edward B. Raymond, general superintendent of the Schenectady works of the General Electric Company. This book had its origin in a number of lectures delivered by Mr. Rosenberg to the workmen and staff of a large electrical manufacturing firm, in order to give them a more practical insight into the knowledge and operation of machines and apparatus with which they were concerned.

This book does not deal with the design or preparation of electrical machines, but gives, in a clear and concise manner, the best and most practical methods of operating electrical apparatus, in locating their faults, together with the reason and a cure for the latter.

It comprises, besides the fundamental phenomena of the electric current, dynamos and motors for continuous, alternating and three-phase current, accumulators and other apparatus, measuring instruments and the subject of electric lighting generally.

The book is substantially bound in cloth, and may be had from any book seller, or will be mailed direct, postpaid, by the publishers upon receipt of the price, which is two dollars.



DEVOTED EXCLUSIVELY TO THE INTERESTS OF ELECTRIC LIGHTING AND POWER STATIONS.

VOL. 6, NO. 11. NEW YORK, MAY, 1907. ISSUED MONTHLY

Central Station Light, Heat and Power Principles

BY NEWTON HARRISON

Alternating Current Motors.—Motors run by means of the alternating current, may be grouped into two general divisions as follows: First, Synchronous motors, or motors which must be speeded up to fall in step with the alternator current operating them. Second, Induction motors, or motors whose armatures and fields are related only inductively, as may be found in the primary and secondary of a transformer.

Another class of motors, which have been appearing with greater and greater prominence in the field of electrical practice, are series wound, single phase in character. On the basis of the above facts, there appears to be a variety of ways of producing mechanical energy by means of an alternating electric current.

The Synchronous and Induction Motor.—The alternating current in its simple form, single phase, as it is called, will not start an alternator to be used as a motor from a condition of rest, unless it possesses the same number of poles and is speeded up, as remarked before, until it is in step with the alternator. The motor and alternator are then said to be in synchronism, but, as has been stated, to give rise to synchronism, the alternator serving as a motor must be speeded up.

Devices have been employed to serve this purpose, consisting of either means to split the phase and thus develop temporarily the effects of a two-phase current, or to use a communtator and series winding, Fig. I, on the armature and field respectively. In this latter case, the alternating current serves to operate a series motor through the medium of the commutator and winding; then when the requisite speed is secured the alternator is employed entirely as a synchronous motor.

The induction motor operated by a two or three phase current, is self-starting. It consists of a field so constructed that the two or three phase current creates within it all the effects of a rotating wave of magnetism. A laminated iron armature, around whose periphery are set copper bars parallel to the shaft, will start itself from a condition of rest when exposed to the influence of the rotating field.

The Series Wound Motor.—The series wound motor, Fig. II, has recently risen to considerable prominence as serviceable for railroad purposes in connection with single-phase currents. Their con-

struction on a large scale, will have great influence on power transmission plants in that they remove the necessity for the conversion of the power into a direct current. It can be transformed down to a pressure suitable for railroad purposes and need not be generated as other than a single phase current. Experiments performed in this direction give great promise of future usefulness. The series wound motor employed for this purpose is constructed in all essentials like a direct current machine, but particular attention is paid to the inductance. This is regulated by the design to meet the conditions of practice.

The theory of the operation of a direct current series wound motor readily indicates that the relative polarity is simply reversed, Fig. III, when an alternating current passes through. If, for instance, the two field poles in a bipolar machine are north and south, the armature polarity will also have a certain position due to the winding on the same. If everything is mutually reversed, the same direction of attraction will still ensue, and therefore the motor rotate in the same direction regardless of the direction of the current and therefore irrespective of the fact, as to whether it is an alternating current or not.

The Erie Railroad Equipment of Single Phase Motors.—The cycles of current for regular railway purposes vary between 25 and 15 per second. In the case cited, the system of motors and the control was as follows:

1st. Single phase railway motors.

2nd. Multiple unit control of the system.

3rd. Pantagraph trolley.

4th. Trolley wire supported by steel catenary construction at a height of 22 feet, except under bridges.

5th. Trolley voltage, 11,000.

6th. One sub-station feeding 34 miles of track.

7th. Power received from a power station 90 miles away over a 60,000 volt transmission line.

The series motor, from this standpoint, represents a form of practical application, that will widen in influence, if the present severe tests are of an average type of success.

Provided the design is carefully followed out, the series wound motor offers no objections of a serious character for lighter work such as the driving of fans, or the operation of small machines such as dental devices or sewing machines, etc. The point in their design of the utmost importance is the inductance.

Effects of Inductance.—The winding of a motor carrying an alternating current must be such that the impedance is not sufficiently great to choke the necessary amount of power for driving the attached machine. This is of such general application in the design of coil windings for all alternating current apparatus that the impossibility of accomplishing definite results otherwise is obvious. The general effects of inductance are such that impedance is manifested primarily, the consequences of which are a limitation in current carrying power of the circuit for the conveyance of power. The idea is well exemplified in the case of a choke coil connected to a lighting circuit. The choking effect becomes more and more magnified as the inductance in the coil is allowed to increase. The increase in inductance naturally causes a greater and greater separation between the two elements of power, namely, the volts and amperes. The diminution in power as this difference is augmented, brings clearly to view the meaning of the apparent power and the available power. The current the motor seems to be taking, and its actual consumption of useful amperes, represent a ratio which, in connection with the work that is or should be done, present the degree to which the design has been a success. A very large power factor means a closeness of agreement between the useful and the apparent energy consumption at a point of high load. A low power factor means the very opposite of this, and in consequence, if it is found at a time when the motor load is high, the conclusion must be drawn that the inductance is incorrect.

Advantage of the Synchronous Motor.—A striking advantage of the synchronous motor is found in its ability to develop some of the qualities of a condenser when its fields are too strong. The effect of this is of interest in the following manner: First, the inductance, otherwise residing in the circuit or system, is by this means reduced; and second, because the reduction of the inductance leads to a raising of the power factor as a whole.

The idea lying behind this statement of the conditions thus existing and the effects resulting, may be discovered in the relationship of the lead and lag in a circuit containing both inductance and capacity. In certain cases, where series motors were used to operate fans, the inductance was partly neutralized by condensers fitted into the bases of the machines.

Several of the large manufacturers use a series winding to start synchronous motors of the single-phase type. In this case, the armature winding

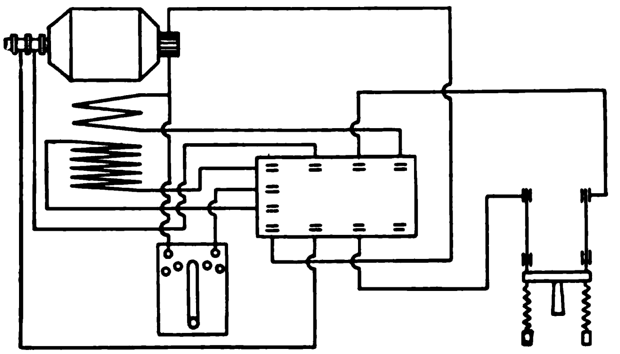


FIG. 1.—SYNCHRONOUS MOTOR MADE TO BE SELF-STARTING BY COMMUTATOR AND SERIES FIELD WINDING.

and field bear exactly the same relation to each other that they would under ordinary conditions. After getting up to full speed, the low resistance field and commutated armature winding are thrown out of circuit, and only the collector rings are

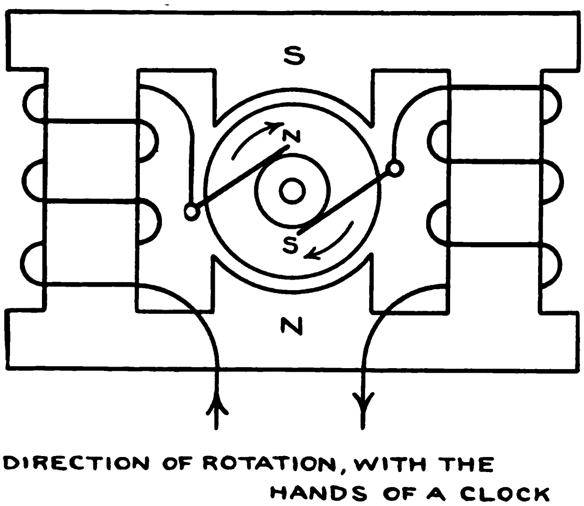


FIG. 2.—THE SERIES WOUND MOTOR. CURRENT FLOWING THROUGH IN ONE DIRECTION.

employed. The armature, with its commutator end still suplying the field with a direct current, is otherwise a synchronous motor in step with the alternator it is in circuit with. The two or three phase synchronous motor is self-starting without the above appliances, but it is not in a position to carry a load until in perfect synchronism. When in this condition, however, the load may be applied after closing the field circuit.

The Starting of Induction Motors.—In the case of the induction motor, the method of starting up consists in attaching the stator to the line, and then utilizing a compensator, as it is called, between the stator and the line to control the incoming rush of current. The rush is so excessive, in the case of large sizes of induction motors, that the conditions

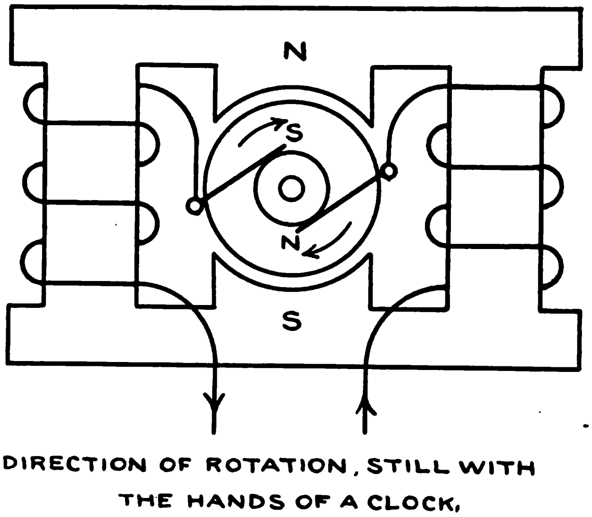


FIG. 3.—THE SERIES WOUND MOTOR. CURRENT FLOWING THROUGH IN A REVERSED DIRECTION.

in the circuit would be disturbed unless a resistance, inductance or their equivalent were employed, either within the machine, or as is generally the case, outside of it.

Small Induction Motors.—In the case of small

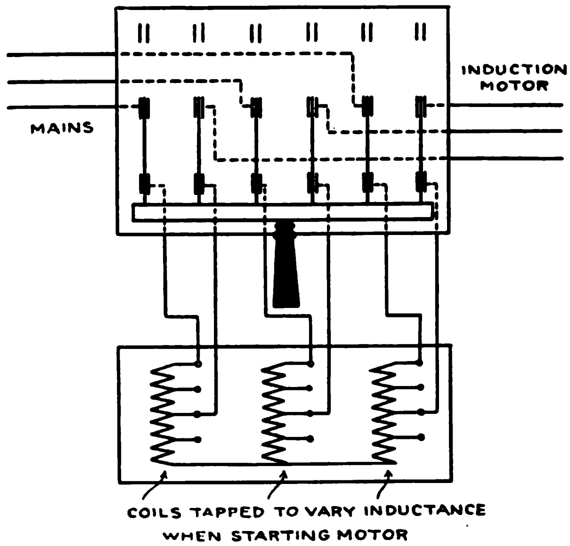


FIG. 4.—STARTING COMPENSATOR, SHOWING CONNECTIONS TO SWITCH CONTACTS.

induction motors up to several horse-power, the disturbance is not so great, when the stator is

thrown dead onto the line. Fan motors are not sufficiently great consumers of current to cause any marked variation in the line when thrown on, except in such cases as those in which a great many are used on one circuit.

The Starting Compensators.—The starting devices or compensators, used for the starting of large induction motors are auto-transformers so-called, Fig. IV, or transformers with only one coil, but whose inductance can be regulated, increased or diminished by cutting parts of it in or out of the circuit. The compensator coils are wound in such a manner that their terminals are conveniently used for obtaining variations in the inductance when necessary. A core of divided iron is used, and the choking effect the coils exercise on the current entering the stator cuts it down to its correct value. The starting current otherwise, in the case of an induction motor, would be about three times its rated current at full load.

Prepared for THE CENTRAL STATION by Colin P. Campbell, Attorney.

Liability of Power Company to Boy Injured by Contact with Wire While Climbing Tree

Action was brought by Willie Temple against the McComb City Electric Light and Power Company to recover for injuries sustained by contact with one of the wires of defendant's lines. Plaintiff was a boy ten years old. The declaration alleged that the defendant in transmitting electricity, which is known to be a dangerous agency, through a thickly settled part of McComb City, had negligently removed the insulation from its wires at a place where the wires passed through a tree, which had numerous branches extending almost to the ground, in which plaintiff and other children played. The declaration further alleged that by reason of the removal of the insulation from said wires they therefore became dangerous, while if properly insulated, they would have been harmless, and that plaintiff, being ignorant of their dangerous condition, while climbing in the branches of the tree, came in contact with that part of said wires from which the insulation had been removed and received the injuries complained of. The defendant demurred to this declaration on the ground that it did not allege that defendant had reason to believe that the wires were so constructed and in such place and manner as to result in injury to plaintiff or anyone else: that it was through the fault of defendant that plaintiff was injured; but that on the other hand shows that it was through the fault of plaintiff that said accident occurred. The trial court held this demurrer to be good, thereby holding that as the declaration did not show knowledge of the danger to defendant he could not be held liable, and also in effect holding plaintiff guilty of contributory negligence. From this judgment plaintiff appealed, and in the Supreme Court it was said: "The citizens of a municipality have a right to a reasonable use of the streets, not only on their surface, but above their surface. Many uses of the streets, on the spaces above the streets, may be imagined in cities where buildings are erected twenty to fifty stories high, that might not be available in an ordinary home. The corporations handling the dangerous agency of electricity are bound, and justly bound, to the very highest pressure of skill and care in dealing with these deadly agencies. The defendant had the right to such reasonable use of the streets for its poles and wires as the conditions existing at the time in the community warranted. On the other hand, the plaintiff had the right to what was a reasonable use of the streets on his part. The

rights of the appellant and the appellee are mutual and reciprocal. Neither could so use his own rights as to wantonly injure the other. These two correlative rights, if the law is obeyed, operate in perfect harmony with each other. There are no interferences and no vacancies in the sphere of their harmonious movement.

"The declaration shows that the tree in which the boy was injured, by contact with an insulated wire, was an oak tree, a little tree, abounding in branches extending almost to the ground, just such a tree as a small boy in any community would be attracted to and use in their play, whether this appellee (defendant) that this particular small boy was in the habit of climbing this tree or not, it is clear from the averments of the declaration that it did know the tree, the kind of tree, and, knowing that, knew what any person of practical common sense would know—that it was just the kind of tree children might climb into to play in the branches. It is perfectly idle for the appellee to insist that it was not bound to have reasonably expected the small boys of the neighborhood to climb that sort of a tree. The fact that such boys would, in all probability, climb that particular tree, being the kind of tree it was, was a fact which, according to every sound principal of law and common sense, this corporation must have anticipated. The argument that it did not almost suggest the query whether the individuals composing this corporation, its employers and agents, had forgotten that they were once small boys themselves. The immemorial habit of small boys to climb little oak trees filled with abundant branches reaching almost to the ground, is a habit which corporations stretching their wires over such trees must take notice of.

"This court, so far as the exertion of its power in a legitimate way is concerned, intends to exert that power so as to secure, at the hands of these public utility corporations, handling and controlling these extraordinarily dangerous agencies to the very highest degree of skill and care. The judgment is reversed."

Temple v. McComb City Electric Lt. and Pwr. Co. (Miss.), 42 So. Rep. 874

We cannot pass this rather unusual case without comment. The rule of this decision is that when an electric company stretches its wires through a tree which boys can readily climb, it is bound to cover such wires, whether it knows that boys are in the habit of climbing the tree or not. On the ground that it is bound to know the habit of boys, and may reasonably expect that they will by climbing the tree come in contact with the uncovered wires.

This doctrine is extreme and is closely akin to the doctrine of the Turntable cases on the one hand, and of Burnip's case on the other. The rule of the Turntable cases is that one is liable when he leaves something on his own property that is naturally attractive to children, within their reach, when in playing therewith, as with a turntable, or mill, or pond of water, they are injured. Burnip's case is an old English case, and its rule is that one who leaves something dangerous, but attractive to children, in the street, is liable, if in playing with it they are injured. Many of the States refuse to adhere to either of these rules. But in the case under consideration we have a rule which is a far greater stretch of the rule concerning the use of one's property, so as not to injure another, for the basis of the cases referred to is the attractiveness of the dangerous thing, but attractiveness does not enter into the Temple case, as there can be nothing attractive about the wire, but only about the tree, consequently, unless the wire is so situated that a boy climbing the tree must necessarily come in contact with the wire, the case should hardly be followed, for as the wire is not naturally attractive the company ought not to be held liable if the boy must go out of his way to come in contact with it.—[Ed.]

Validity of Exclusive Grants—Continued.

This subject, while very important, would hardly warrant the space we are giving it were it not for the variety of aspects which it presents under the authorities and were it not for the different viewpoints assumed by the courts with respect to it.

In an earlier article we discussed a Missouri case relating to this subject, along with other State cases, and found the rule favorable to exclusive grants. Subsequently the city of Joplin was enjoined in a suit in the United States Court from entering into a competing business. In this case the facts were that the City Charter gave to the city authority to either construct an electric plant of its own or grant that right to a private person or corporation. The city chose the latter mode of supplying itself and its inhabitants with light. Later

the city, desiring to go into the lighting business, issued its bonds, erected a plant, strung its wires, established a schedule of rates and went generally into the business of electric lighting. The previously organized light company then began suit in the District Court of the United States, claiming that its rights were being invaded by the city in such manner as to impair the franchise under which it was doing business, and that, consequently, as the franchise is a contract, that there was an impairment of the obligation of contract protected by the Federal Constitution. The District Court enjoined the city from continuing the business of electric lighting, and the city appealed to the Federal Supreme Court. Mr. Justice McKenna, in writing the opinion of the court said: "It is from the statute and the ordinance passed under it, not from the explicit expression of either that the conclusion is deduced that the city is precluded from erecting its own lighting plant; and yet it is conceded that the grant to the company is not exclusive. That is, it is conceded that the city has not exhausted its power under the statute by the grant held by the company, but may make another grant to some other person. In other words, that the city may make a competitor to appellee, but may not become such competitor. The strength of the argument urged to support the distinction is in the consideration that competition by the city would be more effective than competition by private persons or corporations—indeed, might be destructive. The city, it is further urged, might be indifferent to profits, and could tax its competitor to compensate losses. But this is speculation, and may be opposed by speculation, and there are besides countervailing considerations. The limitation contended for is on a governmental agency, and restraints upon that may not be readily implied. The appellee concedes, as we have seen, that it has no exclusive right, and yet contends for a limitation on the city which might give the company the advantage of a practical monopoly. Others may not seek to compete with it, and if the city cannot, the city is left with a useless potentiality while the appellee exercises and enjoys a practically exclusive right. There are presumptions, we repeat, against the granting of exclusive rights and against limitations in the powers of government." Consequently a grant exclusive as against the city will not be implied merely from the grant of a franchise, and the court will not prevent a city which is merely the grantor of a lighting franchise from entering into the lighting business in competition with its grantee. Joplin v. Southwestern Mo. Lt. Co., 191 U. S. 150 (1903).

A cognate case involving the same principle, but concerning a water franchise, is Walla Walla v. Walla Walla Water Co., 172 U. S. 1. In this case the city had granted a franchise to the company and had agreed in that franchise not to enter into the business of supplying water in competition with the company. This the city undertook to do and suit was brought to prevent it by injunction. The Supreme Court of the United States sustained the franchise, and the injunction was granted. The court said: "This court has too often decided for the rule to be now questioned, that the grant of the right to supply gas or water to a municipality and its inhabitants through pipes and mains laid in the streets, upon condition of performance of its service by the grantee is the grant of a franchise vested in the State, in consideration of the performance of a public service, and after performance by the grantee is a contract protected by the Constitution of the United States against State legislation to impair it." Continuing, the court held that the contract did not create a monopoly void as against public policy; that the contract was not void as an attempt to contract away part of the governmental power of the City Council, as the police power of the city to regulate the company still remained the only limitation on the power of the city, being that it could not violate the express stipulation of the franchise by entering into a competing business. It was also said that the franchise did not create a monopoly, as the city might still grant a franchise to another company.

Under the Federal statutes the Territories are forbidden from granting any exclusive franchises. 24, U. S. Stat. at Large, 170. Consequently a city in a Territory may not grant an exclusive lighting franchise, and if one is granted an action is not supportable for its violation. Oklahoma v. DeWolfe. 13 Okl., 454.

The 30th Convention.

The 30th Convention of the National Electric Light Association will be held June 4th to 7th, in Washington, D. C., at the New Willard Hotel.

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High Efficiency Lamps

The trend of modern invention in the field of lamp construction is in two well-known directions. One is established as that which tends to increase the life or durability of the lamp. The other is that which tends to reduce the amount of power it consumes per candle. It has often been noticed in the history of great inventions, that the first progress made is often sensational on account of its rapidity and high quality. The resources of nature as far as materials are concerned, and of the mind, as far as further invention is concerned, seem to be at least temporarily exhausted; and in consequence of this, the stage of invention, as well as application reached, yield no further results.

This resting point may be found not only in the history of the steam engine, dynamo, and other noteworthy inventions, but in the case of the incandescent lamp as well.

In other words, the application of the invention seems to be in comparison as important and as lengthy a period before complete consummation is attained, as the process of improvement in the first stages of the fundamental development. The incandescent lamp particularly represents the case in point, and in consequence, the most noteworthy feature of the case to-day is the new attack, so to speak, after the breathing spell has passed, in the effort to reach a still higher pinnacle of successful and practical inventiveness.

What have been described as high efficiency lamps are of particular interest to the central station man, from several important standpoints. In the first place, he is attracted to the proposition by the fact that they are a distinct advance, from an economic point of view. In the second place, they represent a source of greater satisfaction to the customer or consumer because of their diminished power consumption. In the third place, they attract attention, from a purely business point of view, because of the increased capacity of the station to supply as many more lamps as may be represented by the advance in per cent. of gain of the new lamps over the old.

Perhaps high efficiency lamps might be better designated by the title of "larger profit" lamps, for the obvious reason that a thousand more lamps burning than before, in a system whose kilowatts have not been increased, mean an increased income from exactly the same investment in a general sense.

Where a $100,000 plant earned a net income of $8,000 a year with a given class of apparatus, and the income could be increased to $10,000 a year or over by a slight change in the lamps, the slowness of the change might readily denote a sluggishness on the part of the management of a most reprehensible character. The point, however, which is to be carefully remembered, is that new lamps must be tried as a matter of general principle as soon as they appear. By tried is meant a little more than a test of a nominal nature. A batch of customers ought to be given a chance to frame an opinion, for reasons that will even rise superior to the purely

scientific and commercial tests ordinarily accepted as gospel in its highest form.

The average customer does not judge lamps as do engineers, experts, managers of central stations or even lamp makers. What they examine into first is whether they like it or not, merely as a light. If they don't like it, it goes out whether it is cheap or even offered for nothing. There is a somewhat subtle aesthetic side to the question that quite a few inventors have experienced. If the light satisfies, as a source of illumination, then the inquiry into cost follows. The taking of the opposite point of view is often a mistake of the first order, though it may be committed again and again.

A too intense light, or one of questionable hue, is by far less appreciated however saving it may be, than one with a genial yellow glow that saves less power. The high efficiency lamp question therefore discloses the horns of a dilemma. If the high efficiency is reached by means of a very white light that painfully affects the eye, questions are immediately raised as to its advantage over the more agreeable yellow light of lower efficiency lamps. If the light is not white, but of a different color, or if the light when white is transmitted through globes that create an immediate loss of twenty or thirty per cent. of the light the problem still remains unsolved. A high efficiency and an agreeable color are the practical requirements of the hour.

Air Cooled Transformers

When it becomes a question of choice between the transformers representing different types of construction, the air cooled is generally selected as typifying safety and cleanliness to a somewhat higher degree than the others. One of the difficulties that generally attend the use of air protected apparatus in any case, is the variation in insulating power it then represents as the air changes according to the pressure humidity and temperature.

For these reasons, aside from the cleanliness, the air transformer is not a superior type of construction; but if the safety from more pronounced fire risks, and the freedom from oil and gum is balanced up in the scales on one side, against the inferior insulation of a variable dielectric like air on the other side, then some conclusions can be reached as to the meaning of the comparison.

When sudden, violent discharges of high potential attack the integrity of a transformer, experience has shown the superior advantages of oil as a resistant insulating fluid of reliable character. The transformer may be punctured again and again, and the oil will eventually percolate through until it reaches the break and heals it electrically without the necessity for repair or inspection.

The air transformer is not as safe in this respect, for the reason that the static flash will provide a bridge over which the generated energy of a lower potential will cross, with the result that burning occurs in the neighborhood of the puncture and fire may become imminent at once.

The use of transformers in general, in connection with high tension systems, is an invitation to lightning discharges to make demonstrations at that point unless excellent means are taken to effectively ground the neutral leg if the system so permits.

Ordinary insulation is comparatively useless when exposed to the disruptive influence of several million or more volts of a static discharge. It seems, on a close examination of the oil insulated transformer, that the advantage of oil as a means of permeating through breaks is absolutely equalized by a body of perfectly dry air exposed to equal conditions. In other words, dry air and oil are good insulators for transformers with the advantage of greater effectiveness in favor of oil when the air is not dry and breaks or punctures occur, and the advantage against oil if the discharge is sufficiently powerful to cause ignition despite protection. What are called static by-passes in connection with each coil, are a means of preventing the discharge choosing the insulation, as it is apt to ordinarily. The insulation must be very high, whatever the insulating method may be, oil or air; and the use of protective devices such as by-passes, as well as a ground system if possible, are matters of ordinary common sense. With such precautions as these, the air-cooled transformers have a future in service almost on a par with those depending upon oil in the customary manner.

Sodium Conductors in Place of Copper

That another metal than copper would ever be used for a conductor in a general way, is hardly a foregone conclusion, except in the case of aluminum, in which the comparison is that of three to one in favor of copper. In the monthly consular

and Trade Reports of April, 1907, the following statement may be found: "The use of sodium for overhead transmission is attracting the attention of electricians. It is said to be cheap and a good conductor of electricity, but as its marked affinity for oxygen causes it to unite when placed in contact with water, its employment in the form of a conductor would be limited, probably, to overhead transmission lines or feeders for railway work. The general process of constructing sodium conductors is to take standard wrought iron pipes and heat them to a point well above the melting temperature of sodium. The sodium is then melted in special kettles and is run into the pipes, solidifying when cool. There is said to be no marked depreciation of either the sodium or the pipe if the latter be properly protected by a coat of weather proof paint. For the same conductivity, the price of the complete sodium conductor is much below that of copper cables, being in small sizes, not more than 50 per cent., and in large sizes not more than 20 per cent. of the cost of copper. For instance, a half inch wrought iron pipe filled with sodium has a capacity of 109 amperes, and costs about 3.5 cents per foot, against 8.5 cents for a copper line of the same capacity. A 6-inch sodium conductor would carry 8,130 amperes, and the cost of the line being about $1.40 per linear foot, as compared with $6.30 per linear foot for copper. These figures were estimated on the basis of 7.5 cents per pound for sodium and 16 cents per pound for copper. The proposition as above outlined is a little less than startling, yet it has been given dignified mention by the Bureau of Manufactures of the Department of Commerce and Labor of the United States. The use of a metal whose conductivity is 37, as compared with copper at 100, generally regarded as merely a laboratory curiosity in one respect, and a constituent of table salt on the other hand, for the purpose of commercially conducting electricity in large quantities over long lines, if at all plausible, merits careful consideration.

The elimination of moisture may be accepted as possible, because of the fact that ordinary lead covered cables as at present in use are so built and treated that the moisture is expelled and the cables sealed when in service. The use of sodium in pipes is likewise a practical scheme, particularly if it is placed there while the pipes are very hot. But as to whether a metal of this peculiar character could otherwise meet with the requirements of practice is a question that no amount of theorizing can adequately answer. Its conductivity is greater than that of aluminum, however. The proposition as it stands is startling enough. There now remains the opportunity for those whose interest is awakened to make tests and bear out or refute the statements made under the seal, so to speak, of the Government of the United States.

Electrical Surges

What Charles Proteus Steinmetz defines as low frequency surges, and high frequency oscillations, represent in themselves, and in all the variations that lie between these extremes, the effects of lightning discharges. The low frequency surges approach closely in character the fundamental wave, with but few of the harmonics present. On the other hand, the high frequency oscillations are full of harmonics, though some of the lower harmonics may be absent.

The features about any discussion, of lightning discharges that appear most prominent, and should be recognized as summing up the situation, are as follows: First, that high frequency oscillations are not as dangerous in a destructive sense as the low rate surge. Second, that the electrical surge is not at all restrained by inductance placed in its path. It would seem, to the unbiased critic, in the light of these revelations, that a station is not completely protected unless the protection assumes such a form that both high and low rate movements of electro-static energy, and those rates which lie between, be met with adequate apparatus in the form of arresters.

The deduction drawn leads to the idea of an automatic device, whose inductance and air gaps adjust themselves to the nature of the moving electrical energy. As Steinmetz says, speaking of low frequency surges: ". . . . inductance offers no obstruction, but due to their high power and wide extent considerable damage may be done all over the system." According to this inductance will not check a powerful low frequency lightning discharge.

The Illuminating Engineer

As is now well recognized, the correct design of illumination for any given area is based on fundamental mathematical laws. The correct application

of these laws, however, requires long experience, careful calculations, good judgment and a fine sense of the artistic. While it is generally best to take up any engineering problem directly on the ground, it is nevertheless possible, in most cases, to correctly design the illumination for any given area by a study of the plans and elevations of the building or room.

As an example of what it is possible to do by careful design may be mentioned one large public building recently completed. This building was originally designed for the equivalent of 20,000 16-c.p. lamps. Although the outlets were not placed so as to get the maximum results, nevertheless by careful study of conditions, correct design of fixtures for illuminating as weww as artistic effect, and the selection of the right glassware for each place, the load has been reduced to the equivalent of 15,000 8-c.p. lamps resulting in a saving of over $25,000 annually.

By the selection of scientifically constructed glass-ware, it is possible to obtain perfect diffusion and at the same time direct the maximum amount of light in the desired direction. This is one of the strongest features of the well-known Holophane System of Illumination.

In communicating with any of the engineering departments now being maintained by most up-to-date companies in this field, it is advisable to send drawings or blue-prints of the building to be illuminated, giving, if possible, the location of furniture, the uses to which each room will be put, color scheme, etc.

It is often possible to get good results in a number of different ways, thus affording rather a wide latitude in the matter of preference as to what method of illumination is wanted, such as ceiling lighting, bracket lighting, etc.

The Holophane Company has been a pioneer in the movement toward better illumination and has established an engineering department whose force is composed of some of the best known illuminating engineers. A large number of extremely efficient and artistic installations show commendable results of the expert efforts of this staff whose services are offered to those interested free of charge, whether or not it is desired to use the Holophane System of Illumination.

CURRENT IDEAS

For Furnishing More Light, Heat and Power from Central Stations

Organization and Conduct of a New Business Department Suitable for Central Stations in Cities of 50,000 Population and Under

By Clare N. Stannard

Organization.—The first step in establishing a new business department should be a careful selection of a manager. Among other qualifications, he should be a man of sterling character, having a broad and liberal education, should be versatile and capable of mingling with all classes of people; possessing a thorough knowledge of the electric business. It is also advisable for him to be well posted on the gas business, thus being abe to intelligently meet competition. He should be a man of executive ability and have the faculty of being popular with the public, possessing the ability to manage the employees in his charge.

The next step should be

Assuming the city to have a population as stated in the title (all facts and figures presented can be modified to suit varying conditions and population). I would divide it into ten territories, containing an average of 5,000 people, or 1,250 families. It would then be advisable to sub-divide each territory into two districts, one a residence and the other a business. Thus the representatives would have an opportunity of working both classes of trade.

I do not favor paying representatives on a commission basis for appliances sold, for the reason that no discrimination is made as to the value of

revenue secured through the sale of said appliances. Nor do I favor a straight salary basis, for the reason that no inducement is offered for better than average work. However, I favor the plan of basing compensation upon a combination basis, viz., a certain fixed salary plus a commission, said commission based upon the revenue secured and the value of said revenue. It is of course recognized that a contract taken, bringing in a certain sum per year, where no expense for construction is necessary, is of greater value to the company than one where a sum equal to the amount received is to be spent for construction work, therefore the first mentioned contract should pay the representative a larger sum than the latter.

A few of the qualifications of a representative are expressed in the following:

He should be a man of good character; should possess a liberal and broad education and good health. In the selection of representatives, it is wise to, if possible, choose one having necessary qualifications of a power expert. Another should qualify as a sign, window and outlining expert. Another should possess special knowledge pertaining to illuminating engineering. Men thus equipped can very materially assist the other representatives where special technical or expert knowledge is required. Where possible, it is wise for the representatives to be a combination of commercial and electrical engineers. The more knowledge the representatives possess along all lines, the greater the efficiency.

Assuming the city to be now divided into territories as above mentioned, each territory should be taken in charge by one representative, who would therefore, as before mentioned, take care of a residence and a business district.

This department can render great assistance to the commercial department by the engineer or those working with him giving material aid on all large installations of light and power. Their advice is also of great value when working on isolated plants, and the two departments should work in unison, one with the other.

It should be planned to show all electrical devices, and appliances with the proper display of the various kinds of reflectors and glassware designed to properly reflect the light. The effect of decorative lighting should be incorporated; a full supply of staple and fancy electric fixtures should be shown, also different forms of display, window and sign lighting. Electrical domestic and industrial appliances should form a permanent part of the office display. It might be advisable to have a line of electric motors, desk, ceiling and exhaust fans, various styles and forms of electric lamps. A dark room should be prepared for the display of electric lighting, for instance, as shown by reflectors, fixtures, etc.

Clerical and Salesroom Employees.—In conducting a new business department it is necessary to have an efficient office force to properly keep the records of the office and representatives' work. Unless this is done one cannot intelligently analyze the results being secured.

Too great care cannot be exercised in the selection of office salesmen. They should be able to not only sell goods which the consumers ask for, but should possess the ability to create in the simply curious a desire to purchase goods offered for sale.

This feature of the work should be presided over by one of the clerks who would perhaps only devote a portion of his time to same. A list of the vacant houses equipped with electricity should be compiled, with daily revisions. A hotel and boarding house directory might be included in this work. Railway time tables should be on hand, and the public should be invited to make use of free telephone service. In fact, many features intended for public comfort and service could be incorporated under this heading.

If local conditions allow, this department should be maintained by the company and should work in connection with the new business department. An arrangement of this character increases the efficiency and the value of the work done by the representatives.

Consisting of the active officers of the company, including, of course, the general manager, secretary-treasurer, superintendent, chief engineer, commercial manager, heads of important departments, and one or two representatives. This committee should meet at regular intervals for the purpose of discussing all new business matters. Suggestions for improvement or work of the department should be taken up and discussed, and it will be found that from the varied interests represented in this committee, many new and original plans will be formulated. Furthermore a spirit of harmony will be cultivated, which will in turn be transmitted to all

departments of the company, a most important factor in the conduct of new business work.

Conduct.—Should be presided over by the new business manager, at which time orders should be given and discussed, reports received from the representatives, giving a record of the previous day's work, preliminary reports presented, showing the nature of the proposed day's work. Matters of mutual interest discussed. Verbal reports given by representatives of interesting and important contracts closed. Thorough discussions of same will result in creating and maintaining interest and enthusiasm. This meeting should be held for a period of one-half hour, usually from 8 to 8:30. It is the universal experience of representatives attending meetings as above described that the time thus spent is of a most profitable nature, and the efficiency of their work has been greatly increased.

Should be held each week. Some name similar to the following might be given the organization, viz., Commercial Council. An organization should be formed, having permanent officers, consisting of chairman, vice-chairman and secretary-treasurer. Meetings should be presided over by a chairman, conducted along the lines of parliamentary law. Educational matters should be taken up and discussed, the meeting usually being held for a two hours' evening session. Papers of interest should be presented and discussed. Debates on pertinent subjects should occur. It might be of interest to have two representatives occasionally give an exhibition of how a sale should be made, one acting as salesman and the other as customer. In this way many effective arguments can be presented which will assist those listening in their daily work.

The holding of this meeting gives the representatives an opportunity of discussing many important matters, which, on account of limited time, cannot be taken up at the morning meetings. In addition to the features just mentioned, it might be well to incorporate in this work some or all of the features found in the scientific study of salesmanship, a course of illuminating and electrical engineering, and a thorough study of all principles involved in the supplying of electricity for light and power.

A stenographer should be present at both of these meetings, taking minutes of same, afterwards typewriting them, so that they may be placed on file for future reference. Where possible, it would also be advisable to exchange such minutes with new business departments of other companies, thus providing a way for the exchange of thoughts and methods. A representative, in order to be successful in his daily work, should spend a large amount of time in studying the many subjects with which he comes in daily contact.

The giving of practical demonstrations are of great value and should not be underestimated. They might be classified as follows: *Office, Home* and *Church.*

At the office or salesroom the various electrical appliances and devices should be carefully and thoroughly demonstrated. In fact, the last two or three days of each discount period it might be wise to arrange for a competent person to demonstrate electricity as applied to the various domestic uses, showing, among other things, the chafing dish and various electrical cooking and heating appliances. Neighborhood demonstrations can profitably be given in consumers' homes, allowing the consumer to invite a few special friends, the company demonstrator cooking a meal, and using exclusively electrical appliances. In this way very effective advertising may be accomplished.

Church societies are frequently interested in allowing to be given in their church parlors or kitchens a demonstration, at which time various appliances are thoroughly explained, and in this way many ladies forming the various church societies become interested and very materially aid in the popularizing of electricity for domestic uses. Oftimes in interesting churches in demonstrations, as just described, it is found profitable to present the church society, free of charge, with some one or more electric appliance.

Demonstration work can be carried a step further by showing at the office electric motors, fans, samples of signs, window lighting and outlining, and various other ways in which electricity is applied. Money spent in demonstration work usually proves very effective and is rarely wasted.

In organizing this department and carrying forward the work, it is found advisable to first make a house-to-house canvass, carefully carding all prospects, upon the completion of which the company possesses itemized and detailed information showing the amount of possible business to be secured This information, when tabulated, will be found useful and valuable, and is of particular value when the electric company has competition, either in the form of another electric or gas company. When carded, the names and addresses appearing on said

cards provide proper lists to be used in sending out advertising.

Representatives should not only be able to take orders, but possess the ability to sell goods. They should canvass all proposed extensions. One of the most important features of their work is the securing of additional consumption from present consumers. All complaint work should be carefully followed up, and reports made to the office of all poor service, making sure that such service is remedied. Representatives play a most important part in popularizing the company and in lessening of competition. It is important that they watch all new buildings, making sure that all electrical features are incorporated during their construction, that feeds are of sufficient size to take care of lighting other than the interior system, for instance, sign lighting, window lighting, display and outlining. They should visit architects and builders, interesting them in electricity for both domestic and industrial use.

The holding of business already secured is a most important feature of a representative's work. I deem it unwise to ever discontinue any business simply upon the request of a consumer. It will be found in many instances that much business can be held by a representative calling on the consumer. They can aid the advertising work by supplying the one having charge of the advertising with valuable and detailed information.

Is found to be a most profitable way of directing the efforts of the representatives. For instance, on consecutive weeks, it is wise to specialize respectively on signs, outlining, window lighting, power, decorative lighting, additional consumption on present consumers, etc. After specializing a week it is well to have a report of the success attending their efforts on this class of work. It is further found that when specializing, representatives concentrate their efforts, and therefore better results are secured than when working otherwise. It must of course be understood that in doing this work the regular line of work must not be neglected. Many prospects are secured during a week of specializing where contracts are afterwards closed.

It is profitable to assign men to work exclusively upon increasing the consumption of present consumers, explaining to them and interesting them in the installation of additional domestic appliances, also decorative lighting and power, thus increasing the company's revenue very considerably.

The work done by the representatives should be assisted by personal advertising and by the lady demonstrator, providing the Company has one in its employ. Consumers are frequently satisfied with simply using electricity for light, but a study of the matter will soon demonstrate to one's satisfaction that the company's revenue may be materially increased through little or no outlay for construction, by making a very careful canvass as above described.

The new business manager should have direct charge of the advertising, changing daily the ads appearing in the newspapers. He should select the souvenirs, possibly conferring with the representatives as to what they believe to be proper and effective ones. He should devise and use advertising in many novel forms, such as perhaps supplying free umbrellas with a suitable ad to be given to express and draymen, street car advertising, etc. Under his direct and personal supervision, letters should be sent to prospects designated by the representatives. Circulars mailed in special instances. Most important and effective perhaps would be his ability to secure frequently, free of charge, press notices. Too much stress cannot be laid upon the value of this class of advertising, and the manager possessing the faculty of securing this style of advertising matter is indeed fortunate, and such notions are of great value to the company.

A daily record should be compiled, by the office department, and given to the representatives, showing the appliances and orders taken and complaints registered. Thus he is enabled to keep in close touch with all business transpiring on his territory, whether of a personal nature or coming through the office.

It will be profitable for the company to maintain a portable building, in which should be a complete display of electrical appliances. This building will prove a good advertising medium, and through its use many orders may be secured. The office occasionally should supply the representatives with lists, containing the name and address of consumers who use a small amount of electricity, who should be called upon in an endeavor to increase their consumption.

The new business committee, as before described, should suggest many ways and means of assisting the representatives. A representative's room should be maintained in which to hold their meetings, and papers and catalogues should be placed on file for

ready reference. Prizes may be offered to regular employees of the company for the one securing the gratest number of tips which are executed, such tips being given representatives, who are thus enabled to close orders which otherwise might not have been secured.

The Doherty readiness to serve rate on electricity when properly presented by the representative, will be found a most important factor in increasing the company's revenue and popularizing the company. This rate also serves to increase the load curve, and is for tsis and many other reasons of great value to the company.

Upon first thought one only realizes that electricity is applied for the purpose of lighting and power, but the author has assisted in compiling between four hundred and five hundred ways in which electricity is daily being applied. A few of the most important, interesting and novel ways are the following:

Electricity for house cleaning.

Electricity mercury rectifier.

Electromagnets for maturing coffee.

Electric machine for cutting dress patterns.

Arcs for promoting steady and rapid growths of vegetables.

Arcs over oil tanks for bug extermination.

Electricity used in place of an anesthetic for producing insensibility.

Arc and vacuum for taking and printing pictures.

May be incorporated in a representative's work as follows: He should occasionally go over his own business territory at night, thus determining where the dark spots are, and seeking to interest merchants in various form of display lighting. Again, demonstrating to the merchant who has a dark store the value of his neighbor's brililantly illuminated windows or stores. Representatives might occasionally go over their neighbors' territories at night, reporting the next morning meeting suggestions whereby he would seek to improve the conditions found.

The giving of souvenirs is frequently of assistance in increasing the company's business. It is suggested that preference be given souvenirs consuming electricity, such as for instance, curling iron heaters, etc. An expert window dresser might, at certain seasons of the year, be profitably employed, dressing and arranging, free of charge, windows illuminated by electricity; in this way seeking to interest merchants in additional installations of light, also merchants not heretofore advertising by means of electricity.

It should be the aim of all commercial men to secure the hearty coöperation of all the employees, for it will be found that the office, station and line men can frequently assist the representatives in securing business. Representatives should constantly be on the lookout for ways and means of increasing the company's revenues. Men thus employed who have the company's interests at heart who are thoughtful, original and aggressive will prove their worth and value to the company, and will therefore do much to aid in the securing of increased revenue.

Can and have been secured more than compensating companies for the money spent in the new business department. Specifically speaking, through this department, the consumption per K. W. per inhabitant can be materially increased. This is true also of the consumption per consumer, and the consumption per 16 C. P. lamp connected. This department is an important factor in reducing the manufacturing costs per K. W., also reducing the costs per K. W. delivered to the consumer, which necessarily increases the company's profits. The department should be an important factor in increasing the daily load at all times except at the peak, thus lessening the amount of current losses, reducing the cost per K. W. for manufacture and distribution, increasing relatively the profit.

It is further found that each prospect secured serves to assist in developing new ones. It will further be found that the field is inexhaustible. While in some instances the costs to secure new business the first years seems high, the fact must be taken into consideration that the business thus secured remains with the company for years, and is of no further cost. It is not an unusual thing for a new business department to receive in revenue, the first year, three or four times the original investment.

These and many other results have been and are being secured by various companies, thus proving the wisdom of establishing and maintaining a new business department operated along lines as above outlined.

MONTHLY REVIEW OF THE TECHNICAL PRESS

New Incandescent Lamps

By J. Swinburne, F.R.S.

From 1880 until quite recently it seems to have been generally taken for granted that no departure from carbon was possible. Certainly, there were some experiments on silicon. As silicon is very closely related to carbon, it seemed likely that it would make a good filament, but nothing came of it. Attempts were also made to coat carbon filaments with silicon and with boron. ,

It may seem strange that people did not experiment on some of the more refractory metals; but a little consideration will explain matters to some extent. In the first place, the interest was small. Now, when lamps are made by the million, an improvement means a fortune to the inventor. The result is that there are far more people, and especially far more very highly trained men, working on the subject now. Another point is, that in the early days very little was known about most of the refractory metals. During this time, for example, such substances as thoria, ceria, zirconia, and other "rare earths," have become quite familiar to the practical chemist. Again, we have become much more familiar with high temperatures and high melting points through working with the electric furnace.

Carbon lamp makers have now been able to make 200-volt lamps, even of small powers, for some years. When it is remembered that the process of squirting a solution of cellulose into a liquid is now employed for making artificial silk, it will be realized that squirting enables the lamp-maker to make his filaments as fine as he likes. The difficulty, then, is not in making a sufficiently fine thread in the first place, but in mounting it, and above all, in getting a durable lamp of such fine material. If the surface emission is the same, the pressure varies directly as the square root of the cube ot tne length of the filament. Other things being equal, a 200-volt filament is nearly 1.50 times the length of the 100-volt conductor, and about two-thirds of the diameter. It is thus very much weaker. The slow wearing of the surface causes a greater percentage difference in the resistance of the lamp; and there is double the pressure available for causing discharge across from one leg of the filament to the other. The only way the lamp-maker can reach high pressures, other things being equal, is by increasing the size of the lamp, that is to say, making 16 instead of 8-candle lamps. and so on.

We have thus the distribution engineer clamoring for high pressures, and the lamp-maker trying to meet his demand, and making up to 250-volt lamps. The lamps are naturally worse than those made for lower pressures, but the combination of better distribution and worse lamp is on the whole much better for the public, as the gain through better distribution is greater than the loss through inferior lamps.

An American improvement has been introduced by Mr. Howell. The carbon filaments are heated in an electrical furnace to convert them into a form of graphite. This is really perfecting an old process rather than inventing a new one. The effects of high temperature were known long ago.

But as soon as we deal with metal lamps the question of distribution comes up again. How are lamp-

makers to get the metal wire so fine that it will take, say, 200 volts? The metal lamp can only supplant the carbon on the ground of higher efficiency, and the efficiency claimed is much higher. Thus if a carbon lamp of 200 volts and 16 candles has an efficiency of 0.25 candle per watt, it must have a resistance of 625 ohms. To make a carbon of 625 ohms small enough to give 20 candles at 0.25 c.p.w. is a feat, but to make a metal wire to do so is a very difficult matter. But a metal lamp is made to work at, say, 0.75 c.p.w., and that means that for 16 candles there are only 21.5 watts. This means a resistance of 1,870, or nearly 2,000 ohms. To make a lamp filament of metal so as to have a resistance of 2,000 ohms, and only to give 16 candles at a temperature necessary to give such high efficiency as 0.75 c.p.w., would be a wonderful feat. There are two influences which help the metal lamp, however: the resistance of the metal rises considerably with the temperature, as a metal is run not very far from its softening point, and the emissivity of bright metal is less than carbon, so that to give the same light at the same efficiency the wire may be larger. It seems probable, however, that bright metal services increase in emissivity as they get hot, that is to say, they get blacker as they get hotter; a black body being brighter at a given high temperature than a white body.

We thus come upon the weak point of the metallic lamp; it is very difficult to make a small lamp of 200 volts. The questions are, therefore, whether the higher efficiency of the metal lamp will induce us to bring our pressure down to 100 volts or less, on the one hand, or whether the metal lamp can be made to take 200 volts or more either by further perfection by the use of some sort of transformer, or by using larger lamps, say, 50 candles each. Of course, we may take to running the lamps in pairs, or in threes in series, but that does not seem likely. We went through a good deal of trouble of that sort in the early days of the carbon lamp, and it is improbable it will be repeated. Large buildings may be wired on the three-wire system with a dead middle wire; but this does not appeal very strongly to modern engineers, and it is only applicable to new buildings that are not yet wired. If the metallic lamp had come into being 20 years ago it would have commanded its own conditions, but now it has to adapt itself to the conditions already existing The average householder will certainly not put in a special transformer to give him 100 volts and it will take a good deal of persuasion to induce a supply company to convert its three-wire into a five-wire system. At the same time it must be remembered that there are still plenty of 100-volt circuits, and the output necessary to supply these is quite great enough to give the metal lamp a footing which may enable it to prescribe its own conditions in the future. It seems probable, however, that people's ideas of the value of light will alter, and that incandescent gas or large metal lamps will soon lead them to use 50 candles as the normal light at each point. At the same time, the ingenuity which has made metal lamps possible seems quite capable of making 200-volt 16-candle lamps within reasonable time.

When we come to the question, What metals or compounds are available for lamp filaments? we have to consider the melting point, the specific resistance, and the possibility of making the filaments in practice. As to the melting point, it has been quite impossible to melt many of the metals until the electric furnace came into use; but the electric furnace generally deals with the metals in the presence of carbon, which probably alters their melting points. But apart from that, before the recent development of the study of radiation, there was no means of measuring such temperatures as the fusing point of tungsten, for example. Even yet we have no data as to the melting points of most of the refractory metals. The best guide available is the Periodic Law. By using elements whose melting points are known to be high as a sort of guide posts, we can pick out the elements most likely to have high melting points.

The high melting points correspond with small atomic volumes. Electrical conductivity seems to follow the same sort of rule.

In making metal or carbide filaments there are several processes.

A carbon filament may be made first, and this may be coated by electrical heating with other substances, and the carbon can then be volatilised.

The same process can be carried out except that the carbon, instead of being volatilized, is combined, making a carbide. A wire may be deposited electrolytically from a solution.

The material may be ductile, in which case it is drawn into wire in the usual way.

The material may be made in a very fine, smooth powder, and mixed with some agglomerant, and squirted. The squirted filament is then dried.

baked, and heated electrically to get rid of carbon if an organic binding material has been used.

An oxide may be mixed with carbon and made into a paste and squirted. The filaments, after baking, are heated electrically *in vacuo;* the carbon then reduces the oxide, making either metal or carbide according to the proportion of carbon employed. The carbon may be supplied by heating in hydrocarbon vapor.

The oxide may be made into a rod and run like a Nernst lamp, except that the process is carried out either *in vacuo* or in hydrocarbon gas, so that the oxygen is removed, leaving metal.

These are the most likely, or the least unlikely ways of making filaments.

The plan of coating a carbon and then volatilizing the carbon by heat has a heroic ring about it, which promises a lamp capable of very high efficiency; but I want to see it done. Most metals are likely to form carbides rather than let the carbon go off.

The electrical deposition of metal filaments is generally troublesome because most of the metals that might do for lamps will not deposit uniformly enough, and electrolytic deposits of hard metals are not capable of being drawn down into wire. For such a process to be successful the core or mandrel must not be made of a metal that will form an alloy It need not necessarily be metal at all; presumably such a material as nitrocellulose coated with blacklead, or made conductive by any of the ordinary methods, would serve. The resulting filaments would be tubes, of course.

Drawing down fine wire is generally impossible, as few of the metals are ductile. The drawing down of tantalum by Messrs. Siemens & Halske is a perfect triumph when not only the real but the reputed properties of that metal are considered. Tantalum is not soluble in the ordinary acids.

The metal filament is very seriously handicapped by its softness when hot and its brittleness when cold. Many of the metal lamps will run only in one position, otherwise the wire sags. The wires are also very fragile when the lamp is not in use.

It might be urged that alloys should be used for lamp wires, on the ground that many brittle and intractable metals may make ductile alloys. Alloys have generally high specific resistances, and this is, of course, a very great point. Even a very small addition of another metal may increase the specific resistance very considerably. Unfortunately, alloys generally have low fusing points. Where a very fusible and a refractory metal are alloyed, the addition of the refractory to the fusible metal generally first lowers the melting point. The melting point then rises in one way or another, according to whether definite combination occur, until the melting point of the refractory metal is reached. If the metals have about the same melting point, their alloy may be taken as having a lower melting point. This is not a law, however. It is possible, therefore, that alloys may be formed which have very high melting points. Perhaps metals of the same group and series may give refractory alloys. Platinum-iridium has, I believe, a high melting point. Tungsten and osmium are in the same series, but are in the sixth and eighth groups. Tantalum and tungsten are in the same series and neighboring groups.

The addition of a very little of one metal to another may be worth while if it increases the specific resistance very considerably and lowers the melting point very little. The alloys with high melting points generally contain definite compounds, and compounds are often much more infusible than their components.

Alloying has a possible disadvantage in reducing the resistance-temperature coefficient. The rise of resistance is a most valuable property in a wire lamp, as it protects the lamp against over-running, and allowsw it to be run bright on a more variable supply circuit.

One of the difficulties in squirting filaments of a paste of finely divided metals and an agglutinant is to get the metal fine enough to squirt smoothly. This is also a question of the agglomerant used. Some of these metals in the form of powder will not squirt properly; the past comes out thin at first, and then particles choke the nozzle and the squirting stops. Gum tragacanth is a very convenient material to use. It was used by Farneljehm for squirting thin threads of magnesia, out of which he made beautiful little baskets for use as mantles on water-gas burners. These have been supplanted by the Welsbach mantles. After a metal filament is squirted it must hold together until it is heated to a temperature high enough to sinter the particles together and make the filament into a sort of wire. Obviously it must be difficult to make very fine filaments in this way; and very fine filaments are necessary for reasonably high pressures. If the agglutinant is carbon there is a chance of its being taken up by the metal, and either making the carbide or

reducing the melting point, just as carbon reduces the melting point of iron or manganese.

Squirting a mixture of oxide and carbon and then electrically heating to get metal does not look promising because the resulting filament will probably contain carbon, or be a carbide, or else the metal will be only a sort of framework, as the volume of the metal must be less than the volume of the oxide, plus enough carbon to reduce it. Such a filament will have a large diameter for a given weight of metal, and will most likely be very weak.

It may often be easier to squirt a very fine filament of pure oxide than of metal powder. The oxide can then be reduced, in many cases in hydrogen or even carbon monoxide, without forming carbide. In some cases I have found very fine "impalpable" powders can be made by calcining such salts as the oxalates. Prolonged kneading has a marked effect on the extrudibility of many pastes. A paste is much improved by being worked for hours in a small Pfleiderer, or by more powerful kneading. The attrition of the particles seem to grind their corners off.

A filament made by reducing a paste of oxide with hydrogen is also more likely to be dense and strong than one which had the reducing material in its body in addition.

The method of making a squirted filament of oxide and reducing it by running it as a Nernst lamp *in vacuo* is troublesome, and does not give much promise of supplying long, thin filaments. If you consider the length and diameter of the Nernst rod for 100 volts, and compare it with a tantalum wire for the same pressure, it is evident that the method is almost hopeless. A wire the length of a tantalum lamp filament and approximately of the same diameter could not be made of oxide, and could not be run as a Nernst filament with any reasonable pressure if made.

Though metal filaments have been referred to so far, it must be remembered that there is no reason to limit the possible conductors to elements. To begin with, we have the first of the new lamps, the Nernst, made of oxides. The stick of oxides, or glower, as it is generally called, has such a high specific resistance that it need not be long and thin to meet ordinary conditions. On the other hand, the rods cannot be made very thin, as the oxide is soft when hot, and is fragile when cold. The smallest rods made are for 0.25 ampere. On 100 volts these give about 16 candles. The makers do not make rods to take 0.125 ampere so as to give 16 candles on 200 volts. As the lamp requires a heater to start it, and an electro-magnet to put the heater out of circuit, and a series resistance, or "ballast," it has always appeared to me that the real field for the Nernst is not in competition with the 16-candle carbon incandescent, but in the region of 50 to 500 candles. The proportion of cost of the electro-magnet, the resistance, and the heater is smaller in this case, and there is a more open field in competition with small arcs and Welsbach mantles.

The Nernst glowers used to be a mixture of yttria, or "yttrite earth" with zirconio, and it is probable the same or a similar mixture is still used. There may be a very large field for improvement here. The conditions are that the rod should stand a high temperature without getting too soft, and it should begin to conduct at a low temperature, so that starting should be easy. On the other hand, the lamp is of course patented, so there is not much encouragement for workers making improvements. It may be thought, however, that it would be better to employ some black substance, such as some oxides or sulphides which conduct even cold, so that preliminary heating might be omitted. It is a very curious thing that there does not seem to be any such black or colored compound in existence.

It may be supposed that a Nernst glower should be run *in vacuo,* so as to avoid the loss by convection. The glower appears to conduct electrolytically exactly in the manner of a fused salt; and it would further appear that with a direct current you would get oxygen at one terminal and zirconium at the other, and that in a few minutes the glower would be entirely reduced to zirconium if the oxygen were pumped out as liberated. What really happens is that the lamp goes out. It does the same in an atmosphere of coal gas. This may be because the zirconium is liberated in a modification which does not conduct.

Zirconium is said to fuse fairly easily; on the other hand, people are said to make lamps of it. As a matter of fact, it is not easy to get such a metal as zirconium pure, and it is quite possible the melting point is very high, and that some particular alloy that was really being examined melted more readily. Nearly all the melting points of such metals are uncertain. Zirconium lamps are made for up to 110 volts at 1 c.p.w.

Tantalum is an exceedingly hard metal, and in its pure state is ductile. It has a specific resistance of

16.5 microhm centimeters cold, or about 85 at the temperature of a lamp. It has a high tensile strength, namely, 93 kg. per sq. mm., or 59 tons per sq. in.

It is drawn into wires of 0.05 down to 0.035 mm.; the large wire gives 25-c.p. lamps on 110 volts. Such a lamp has a filament 65 cm., or 25½ in. long, and a pound of tantalum will make 20,000 of these lamps (Bohm). The tantalum is melted in an electric arc or furnace, and the ingots are heated red, and hammered into sheet, and the sheet is drawn dawn into wire. Messrs. Siemens and Halske intend to make various uses of the marvelous properties of tantalum, and we shall probably soon have tantalum pens, drills, cutting tools, unoxidisable springs, and other desirable objects.

Messrs. Siemens and Halske do not recommend their lamp for alternating currents, and it cannot therefore be as good as on direct-current circuits; but it runs on alternating currents very well though perhaps not as long. On the other hand, it is said that the alternating current alters the physical nature of the wire, rendering it brittle, so that it breaks, not by fatigue, but by any slight shock it happens to get. The Nernst lamp has shown peculiarities in this connection. Some glowers will run with direct and not with alternating currents, and some with alternating only. Direct-current glowers also go wrong if the poles are changed. These mysterious properties of the Nernst do not seem to have anything to do with the behavior of the tantalum lamp, however, but all the same there may be something in common. It is said that the makers have now overcome the aversion of tantalum lamps to alternating circuits. I have heard of tantalum lamps running on the County of London alternating circuits for over 600 hours with no failures. The makers attribute the breakages to the trembling action due to the repulsion of the wire near the bends. This will most likely be overcome by making the zigs and zags so that the wire does not come close to itself. At present they are very acute angles. The wires are often in movement through a sort of Trevelyan rocker effect at the points of contact of the wire with its numerous supports.

Molybdenum is very similar to tungsten, and unless the melting point is lower than that of tungsten, we shall probably soon have molybdenum lamps. The trioxide (the anhydride of molybdic acid) is volatile, and might therefore be used for deposition of molybdenum on a carbon filament, so as to replace it,

Tungsten is a very hard and brittle metal, which is sold in the form of a black powder, or as ferro-tungsten. It was for a long time considered infusible, but the electrical furnace showed, of course, that it could be melted. The powder is difficult to squirt, even mixed with a good deal of tragacanth. Kuzel has invented what seems to be an admirable way of getting over the difficulty. He gets the tungsten in the form of an exceedinly fine powder by employing a method that was used by Bredig for getting what is known as colloidal platinum. An arc is made to play under water between tungsten electrodes, and this is said to produce a very finely divided form of metal. This is collected and worked up into a stiff enough paste and squirted. Tungsten is not an expensive metal, so the only cost is in making the filaments. Whether the filaments of this paste can be squirted so as to be fine enough for 200 volts will be a matter for the future to decide.

There have been processes proposed or worked in which carbon is heated in a vapor of a volatile tungsten compound, such as the trichloride, or oxychloride, in the presence of hydrogen. If the reduction in the case of a chloride is due to the hydrogen, thus involving no oxidation of the carbon, a filament must be obtained of carbon coated with tungsten, or of carbide of tungsten; but if there is any oxygen involved in the reduction, as in the case of the oxychloride, the carbon is burnt out, and the result is a filament of tungsten.

Osmium is a crystalline metal, which cannot be drawn into wire. It is very hard, scratching quartz. The Welsbach osmium lamp is said to be made by making a paste of finely divided osmium and an organic binding material, and squirting it. The filaments are then baked and heated electrically to a very high temperature to eliminate the carbon. The osmium lamp so far produced is for low pressures, as might be expected, but it has a very high efficiency.

Making lamps of osmium must be an exceedingly difficult matter. Apart from the metal being very hard and infusible, it oxidizes in the air if very fine, though this oxidation does not take place if the fine powder has been heated to a high temperature. The peroxide of osmium is very poisonous. It gives off enough vapor at ordinary temperatures to give much trouble, and especially to injure the eyes very seriously. This oxide might be used for replacing a carbon filament with osmium. No doubt that has been tried. The osmium was, I think, the first of the

new metal lamps, and was invented by Auer von Welsbach. It is made up to 75 volts with 40 candles by the Vienna firm, now the Westinghouse-Metallfaden-Glühlampfabrik, but 100-130-volt lamps of only 32 candles are supplied by the General Electric Co., of this country. The rated efficiency is 0.8 c.p.w.

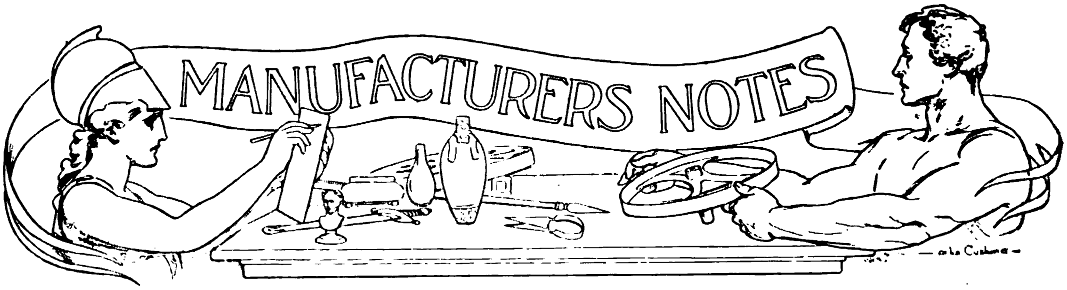
The osmium wire is said to be as small as 0.03 mm. diameter, which is rather less than the finer tantalum wire.

There is some doubt whether the lamps known as osmium are made of osmium or an alloy of osmium or tungsten. Tungsten is a curious metal, and it is not very easy to get into alloys, but it may alloy with osmium perfectly for all I know to the contrary.

Iridium is a very hard and brittle metal. Iridium lamps are being studied by Gülcher. He makes a paste with an organic binding material, and squirts it. The filaments are then heated electrically until the carbon is burnt out, and some particles of metal have sintered together. This lamp, like other metal lamps, labors under the disadvantage of being only for low pressures. It would seem that squirted metal filaments are less likely to be made fine than those made from drawn wire.

It will be asked, what will be the effect of these new lamps on the industry? In the first place, they will increase the output of stations, just as machinery increases labor. But there is more difficulty in foreseeing the result of high efficiency hampered with low pressure. A probable solution is that people will gradually take to using large lamps taking the same pressure, and about the same power as carbon lamps, but giving, say, four times the light.

As to the lamp-making industry, one might prophesy without much danger that the present makers will merely alter their manufacture and make metal lamps. This will pay inventors better, because the existing makers have their commercial organizations and their facilities for distribution. Besides, all the works except the parts devoted to making the filaments will be available. It is possible new works will be set up to make filaments, and that the lamp-makers will buy the filaments and make them up into lamps. There are so many possible ways of making metal filaments, that it is doubtful whether large monopolies can be secured by patents; and it is much more likely that most of the present carbon lamp makers will work out particular processes of their own, and will put their own metal lamps in the market.—*London Elec. Rev.*



Allis-Chalmers Steam Turbo-Alternators Recently Put in Service.

The successful starting of a high power steam driven unit, whether reciprocating or rotary, is always an operation accompanied by more or less liability to accident, due to any one of the manifold elements in design, construction or erection which may influence the final results. The steam turbine, occupying as it does a comparatively new place in the power field, is judged closely by the results obtained, and particularly is its initial performance watched and passed upon accordingly.

As one of the direct results of its many years' experience in designing, building and erecting re-

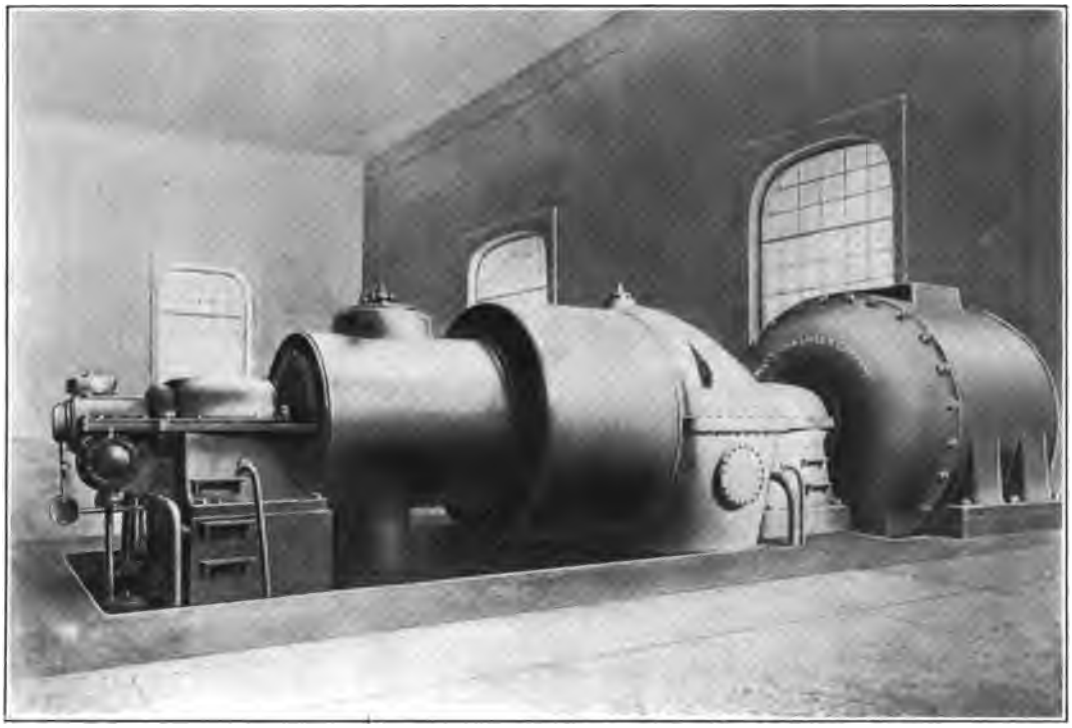
ciprocating engines of all kinds, the Allis-Chalmers Company has been particularly fortunate in successfully placing its steam turbines and generators in service in various parts of the country. Practically without exception those units have been erected, put into operation and accepted in record-breaking time, without accident or mishap of any kind.

One of the first of the large Allis-Chalmers turbo-alternators to be installed was the 5,500 kw. unit at the Kent avenue station of the Brooklyn Rapid Transit Company. Steam was turned on, March 22nd, to dry out the generator. On March 27th, owing to a breakdown in one of the other plants of the Rapid Transit Company, a sudden call was made for power. The new unit was hastily put in operation, and, within twenty minutes after the preparations had been completed, it was delivering 4,000 kw. Since then this turbine has been operating continuously, generating on an average 6,000 kw. and up to a maximum of 8,300 kw., taking heavy loads on the morning and evening peaks.

At the Brooklyn Edison Company's Gold Street Station, the erection of a 5,500-kw. Allis-Chalmers turbo-alternator was begun in April and completed in very short order, the machine being operated for the first time on June 16th.

From then on, this unit has satisfactorily carried all the load to which it has been subjected.

A 1,500-kw. Allis-Chalmers turbo-generator unit at the power-house of the Memphis Consolidated Gas & Electric Co., Memphis, Tenn., was shipped on Sept. 8th, and ready for steam and condenser pipe connections on Sept. 16th. On Nov. 15th, the steam connections were blown out and the machine placed in operation. After running for 15 days, the turbine was accepted. The temperature rise of the generator has always been far below the contract guarantee, and both it and the turbine are capable of carrying much heavier overloads than those specified in the contract.



ALLIS-CHALMERS TURBO-ALTERNATOR.

A 500-kw. Allis-Chalmers unit for installation in the power-house of the Western United Gas & Electric Company of Aurora, Ill., was delivered complete on Oct. 8th. It was ready to turn over on Oct. 11th and the generator was dried out by the 14th. The new unit was put on the circuit Oct. 17th and was immediately called upon to carry an overload, which it did satisfactorily. Since that time this tur-

bine and alternator have undergone rigid acceptance tests both at overload and three-quarter load, with the result of having bettered the guaranteed steam consumption by 8¼% for the overload and 9.6% for the three-quarter load test. The unit has been in continual operation since, carrying all loads placed upon it.

The power station of the City of Jacksonville, Fla., has a 500-kw. Allis-Chalmers turbo-generator unit fully erected and operating and a second unit of the same capacity on the way to Jacksonville. The first unit, as the result of an accident to the other apparatus in the power-house, was suddenly called upon to pull 500 kw. for seven hours straight and a maximum load as high as 700 kw., with entirely satisfactory results.

A number of Allis-Chalmers turbo-generator units shipped within the past month or two have recently been started or are now awaiting steam connection. A 1,000-kw. unit at the power-house of the Kokomo, Marion & Western Traction Company at Kokomo, Ind., has just been erected and the turbine was started up for the first time on the 17th inst.

Out of three 1,500-kw. units for the Milwaukee Electric Railway & Lighting Co., one now being erected will probably be started up in the course of the next two or three weeks. The second turbine has been received on the ground but its erection not yet begun.

Erection of Allis-Chalmers turbo-generators is now in progress in the plant of the Meriden Electric & Lighting Co., Meriden, Conn., where a 500-kw. unit is being installed at the power-house of the Canton Light, Heat & Power Co., Canton, Ohio, where another 500-kw. unit is going in, and at the works of the National Cash Register Company, Dayton, Ohio, where a 1,000-kw. unit is being installed.

Three 1,000-kw. units for the Western Canada Coal & Cement Company are on their way at the present time to the plant of the company, located near Calgary. Units ranging in capacity from 500 kw. to 6,000 kw., are in the West Allis shops nearing completion for the Jamestown Woolen Mills, Jamestown, N. Y.; Savannah Lumber Company, Savannah, Ga.; Flatbush Gas Company, Brooklyn, N. Y.; Indianapolis New Castle & Toledo Ry., New Castle, Ind.; Helderberg Cement Co., Howes Cave, N. Y., and Kings County Electric Light Co., Gold Street Station, Brooklyn.

Lord Electric Company, of New York and Boston, has just issued bulletin E, describing the Shaw Non-Arcing Lightning Arresters.

The principle and every detail of the above type of lightning arrester is clearly described and illustrated in this bulletin, in which are also given the prices, as well as every dimension necessary in ordering or figuring on spaces on switchboards, and their locations where the use of these arresters are contemplated. Mr. Henry M. Shaw, the inventor of the lightning arrester described in this bulletin, was awarded, through the Committee on Science and Art, of the Franklin Institute, the Edward Longstreath medal of merit for his high resistance carbon lightning arresters in January, 1904.

Shawmut Pocket Test Lamp

The considerable annoyance which has occurred from defective indicators in all makes of enclosed fuses necessitating the employment of cumbersome methods to determine blown fuses has led the Chase-Shawmut Company to design the Shawmut Pocket Test Lamp as illustrated herewith, to be

used as a short and convenient method of discovering same. It may also be used to show whether or not a circuit is alive, and in this connection will be found a much more desirable method than the old one of moistening the fingers. It seems as if this device should appeal very strongly to central station men who are constantly coming in contact with such conditions. It is made up of a specially designed incandescent lamp enclosed in a fiber casing. This casing is equipped with binding posts on the ends and is drilled through the middle, allowing the illumination of the enclosed lamp to be plainly seen.

For the majority of switches and fuses the metal sides of the test lamp will bridge the parts of opposite polarity, but if desired for work where there is greater separation the binding posts afford a convenient means of clamping leads of any desired length.

It is not designed for continuous service and should be used only for flashing as the small en-

closed casing will become too hot if left very long in circuit.

The lamp is made in two sizes; one suitable for 110 volt measuring 3⅝" over all with a diameter of 11/16". The other for 220 volt, 4¾" over all, with a diameter of 1 1/16". The metal parts are nickel-plated and the whole makes a very neat device.

We believe that the Shawmut pocket test lamp should find a place in the vest pocket of every central station man.

The Cutler-Hammer Mfg. Co., of Milwaukee, has recently placed on the market a new line of printing press and machine tool controllers. These controllers are of the well-known "Carpenter Type," and embody the distinctive feature of this

VIEW OF NEW CUTLER-HAMMER PRINTING-PRESS AND MACHINE TOOL CONTROLLER WITH COVER IN POSITION.

class of Cutler-Hammer apparatus. The essential difference between the new controllers and the older type is that the former provide for a greater number of field speeds than the latter.

At the time the first "Carpenter" printing press and machine tool controllers were placed on the market it was the accepted practice to obtain the major portion of speed variation by means of armature resistance, the increase in speed secured by means of field control, seldom exceeding 15 per cent. Of late, however, variable speed motors, so designed as to permit of their speed being increased as much as 400 per cent. by field control, have come into use, and the present line of controllers has been designed to meet this new condition in printing press and machine tool work.

Like the older type of apparatus, the new line of controllers is provided with an auxiliary breaking device, equipped with a powerful magnetic blow-out. In opening the circuit by moving the lever to the "off" position the break does not occur on the contracts, but on the auxiliary device located just be-

CUTLER-HAMMER REVERSIBLE, COMPOUND CONTROLLER FOR PRINTING-PRESSES AND MACHINE TOOLS, WITH UNDERLOAD, OVERLOAD AND PUSH-BUTTON RELEASE AND DYNAMIC BRAKE. COVER REMOVED.

low the contact segments. This prevents arcing on the contacts. The contact segments themselves are of hard-drawn copper and are separately renewable.

The controllers are equipped with cast-iron covers, which completely enclose all of the apparatus

CUTLER-HAMMER NON-REVERSIBLE COMPOUND CONTROLLER FOR PRINTING-PRESSES AND MACHINE TOOLS. UNDERLOAD RELEASE ONLY. COVER REMOVED.

except the handle of the operating lever. The lever itself, instead of being cast in a straight bar, as in the older type of apparatus, is formed with a projecting arm carrying the contact shoe for the field speed points. This construction contributes to the compact arrangement of the controller. All con-

tact parts are removable from the slate front without disturbing interior connection and all terminals are labeled with brass tags, insuring proper wiring.

In this new line of controllers the speed regulation is effected by means of both armature and field resistance, the armature resistance being furnished separately, though it is possible to mount it with the front if desired. The field resistance is, in all cases, attached directly to the front of the controller, and provision is made for positively holding the lever of any desired contact.

Six distinct pieces of apparatus are comprised in this latest line of printing press and machine tool controllers—three non-reversible and three reversible. In each class the controller may be had with underload release only; with underload and overload release, and with underload, overload and push-button release and dynamic brake.

The new apparatus is described in Cutler-Hammer Bulletains Nos. 81½, 82½, 83½, 84½, 85½ and 86½.

Pettingell-Andrews Company, of Boston, Mass., the largest electrical supply house in the world, announce that they have secured the entire five-story building, 483 to 489 Atlantic avenue, and extending through to Purchase street, which will be connected with their present extensive quarters, which now occupy a large portion of an entire city block, the building being numbered 156 to 160 Pearl street, 130 to 136 Purchase street and 483 to 511 Atlantic avenue. This new addition to their already large store adds 35,000 square feet more space.

The marvelous growth of this concern has increased thirty-fold since it commenced to be one of the recognized supply houses of this country some fifteen years ago.

The success of this company has been the result of doing business on business principles, honest dealing, furnishing only the highest grade material, and looking after their customers' interests promptly and in every detail.

Minneapolis Steel & Machinery Company, of Minneapolis, Minn., manufacturers of the well-known Twin City Corliss Engines, Munzel Gas Engines and Power Gas Producers, have opened a branch office at 262 Commerce street, Dallas, Tex., under the management of Mr. J. P. Greenwood, the large demand for their steam and gas engines and producer plants in this territory having made this new office a necessity.

The Pittsburgh Gage & Supply Co., Pittsburgh, has recently installed White Star oiling systems in the engine rooms of the following concerns:

Cincinnati Water Works, Cincinnati, O.
Standard Underground Cable Co., Perth Amboy, N. J.
Warner & Swasey Co., Cleveland, O.
Baldwin Steel Co., Charleston, W. Va.
New River & P. Coal Co., Berwind, W. Va.
Berwind-White Coal Mining Co., Windber, Pa.
John Wanamaker, New York, N. Y.
Pittsfield Electric St. Ry. Co., Pittsfield, Mass.
John Roebling's Sons Co., Kinkara, N. J.
Bryan-Marsh Electric Co., Central Falls, R. I.
Louisville Lighting Co., Louisville, Ky.

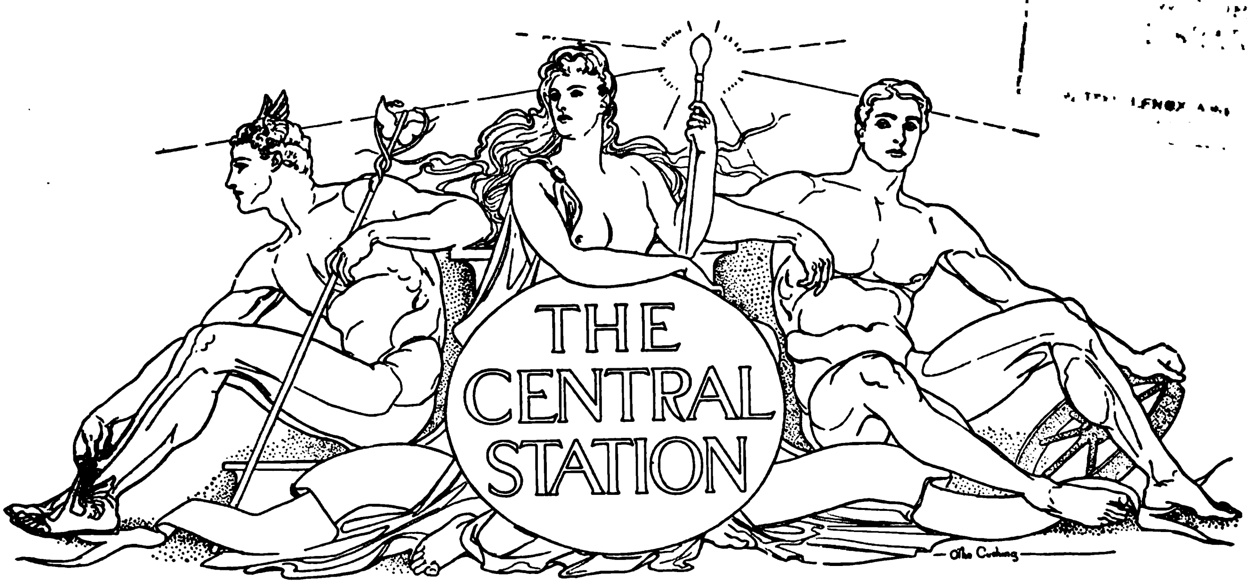
This modern method of lubricating engine bearings is fully illustrated and described in a new catalog published by the above company.

The Economical Lamp Company, of 96 Warren street, New York City, manufacturers of the Economical Turn-Down lamp, which is now meeting with such universal use, not only throughout the United States and Canada, but in Europe generally, are now issuing every month a bulletin devoted to the Economical Turn-Down lamp, showing what a help this useful little article is to central stations as a business-getter.

If you, Mr. Central Station Manager and Superintendent, do not receive this bulletin regularly, just drop the above company a postal card and tell them so.

The Walker Electric Company, of Philadelphia, one of the largest exclusive switchboard manufacturers in this country, has just issued a thirty-page catalog illustrating and describing a few of the large central station switchboards, showing all classes of switchboards.

The illustrations show some of the largest boards in use in the largest light and power stations in this country, and a careful examination of the catalog by central station managers and superintendents will undoubtedly suggest improvements in many of the boards in their stations, which are to-day comparatively obsolete. A copy of this catalog will be sent to any reader of this paper by addressing the above company.



DEVOTED EXCLUSIVELY TO THE INTERESTS OF ELECTRIC LIGHTING AND POWER STATIONS.

VOL. 6, No. 12. NEW YORK, JUNE, 1907. ISSUED MONTHLY

The National Electric Light Association.

ITS OBJECT, ITS CONSTITUTION AND THE PROGRAM OF ITS 30TH CONVENTION.

The first convention of the National Electric Light Association, took place in the Grand Pacific Hotel in Chicago, on February 25, 1885, at which time it consisted of but seventy-one members.

The 30th convention, which is taking place at the New Willard Hotel in Washington, D. C., from the 4th to the 7th of this month, will have on its rolls 1,073 active and associate members.

Within the past twenty years enormous strides have been made in the art and business of distributing electric light, heat and power for commercial and domestic purposes from central stations, and to-day there are, in the United States and Canada, 4,700 electric lighting and power stations, representing a capital invested of nearly eight hundred million dollars, employing upwards of thirty thousand in their business and operating departments, earning in wages and salaries over twenty millions of dollars. Over seven thousand steam engines of various types, with an indicated horse-power of over two millions, and upwards of two thousand water wheels are necessary to furnish the current from these central stations.

Of the 4,700 electric lighting and power stations, over two thousand carry more or less complete lines of electrical supplies, and do most of the wiring and installation for the cities and towns in which they operate.

The object of the National Electric Light Association is to *foster* and *protect* the interests of those engaged in the commercial production of electricity for conversion into light, heat, or power. To secure this object, it is necessary that all companies, firms, and persons interested in the electrical industries be related to each other through the medium of this Association.

In the broadest and best sense, the individual interests of manufacturers can be promoted in no surer way than by the removal of every obstruction to the prosperity of those who use electrical apparatus and supplies. The prosperity of manufacturers in the past has been based on the organization of central station companies. The prosperity of manufacturers in the future must be based on supplying the requirements of existing companies for extensions and renewals.

To secure this prosperity it is necessary that a record be created and maintained, showing that investments in central station plants are safe and profitable. Such a record, made in a way to command the confidence of those who have capital to invest, will induce the purchase of apparatus for extensions, in quantities that will tax to the utmost capacity all existing manufacturing establishments even though not another central station company be organized.

There is a limit beyond which competition cannot go without sowing the seeds of self-destruction. Business competitors cannot, with continued safety to themselves, discredit or reduce the profits of those enterprises upon the prosperity of which their own prosperity depends.

Experiments in the laboratory or workshop, valuable as they may be, cannot remove all impediments to the prosperity of central station companies. The largest number and the most important in character of such impediments have no existence in mechanical appliances. They are found only in the conditions under which the business of rendering quasi-public service under authority of a municipal franchise is compelled to operate. The requirements of State and Municipal Legislation; the intelligence and honesty of members of the State Legislature or Municipal Council; the methods of competing manufacturers; the attitude of the public press; the trend of public opinion—all affect the results of a central station business. Those who have capital invested in, and devote themselves daily to the management of such a business, best know the nature of the difficulties with which they are obliged to contend.

This Association is organized to foster and protect central station interests without regard to the source from which the dangers that threaten such interess may come.

In undertaking this needed work, it does not consider that there is a necessary antagonism between the manufacturers and users of electrical apparatus and supplies. It secures to Associate Member Companies and Associate Members the right to participate in the discussion of papers and topics brought before the Association for consideration. In doing this, it enables such members fully to protect their individual interests and to contribute their share toward establishing the general security and prosperity of investments in central station plants.

Its voting power is vested in those only whose interests are directly affected by every action taken. This is a guarantee that the Association will pursue its objects with consistent and tireless energy, and that its actions will always be intended to foster and protect central station interests.

Further, to secure firm and well-directed management, the Constitution now provides for a permanent Executive Committee, one-third going out of office after each Convention. This remedies a defect from which the Association has suffered more than from any other cause. Such an Executive Committee can make plans for the benefit of members and execute them.

To hold and completely occupy the territory within the practicable working area surrounding it, is the right and duty of every central station company. An infringement upon such territory, from any source, means, to every company so attacked, a loss of opportunity; a loss of business; a loss of profits; not for one year only, but in perpetuity. To assist all companies to hold and fully occupy their territory is the purpose of this Association, in undertaking to foster and protect central station interests.

Infringements upon such territory do not necessarily require the presence of a competitor within it. The policy of one state, and of the towns within it, in legislating on subjects pertaining to central station interests will affect favorably or unfavorably, similar interests throughout the country. This clearly shows that a company's business may be impaired and possibly destroyed by the influence of things done beyond the limits of its own town and state. Central station companies should require no further reasons for becoming members of the National Electric Light Association.

The National Electric Light Association is controlled by no patent, by no system, by no manufacturing interests. It represents the interest of investors in central station plants. An investor's interest is the same in all undertakings, all countries, and all languages; it is ***security*** and ***profit***.

CONSTITUTION.

ARTICLE I.—NAME.

This Association shall be entitled the NATIONAL ELECTRIC LIGHT ASSOCIATION.

ARTICLE II.—OBJECT.

The object of this Association shall be to foster and protect the interests of those engaged in the

commercial production of electricity, for conversion into light, heat, or power.

ARTICLE III.—MEMBERSHIP.

Section 1. Members shall be divided into five classes—Member Companies, Members, Associate Member Companies, Associate Members, and Honorary Members. Member Companies only (Class A) shall be entitled to vote, and shall be private corporations or individuals engaged in the business of producing and supplying electricity for light, heat, or power, for commercial or public use.

Section 2. Members shall be officers or employees of Member Companies, elected and continued only from year to year with the written consent of the Member Company with whom connected, and they shall be distinguished as Class B; and instructors and teachers of engineering and related sciences as shall be in sympathy with and shall approve of the objects of the Association, shall be eligible as members and shall be designated as Invited Membership Class.

Members Class B shall have all the privileges of Member Companies Class A, except the right to vote and to attend the executive sessions of the convention, but shall be allowed to attend such executive sessions upon obtaining the written consent of the Member Company Class A vouching for their membership.

Invited Membership Class shall have all the privileges of member companies, Class A, except the right to vote, to hold office, and to attend the executive sessions of the conventions. Such members shall be invited annually by the Executive Committee.

Section 3. Associate Member Companies shall be electricians, electrical or mechanical engineers, manufacturers—corporations or individuals—who are directly or indirectly interested in advancing the use of electricity. They shall have the right to attend all meetings of the Association (except executive sessions), and to discuss papers read before the Association; and shall be known as Class D.

Associate Members shall be officers or employees of Associate Member Companies Class D, elected and continued from year to year with the written consent of the Associate Member Company with whom connected. They shall have the right to attend all meetings of the Association (except executive sessions), and to discuss papers read before the Association, and they shall be designated Class E.

Section 4. Honorary members shall include those already elected as such, and such other persons as may be elected upon the unanimous recommendation of the Executive Committee and approved by a two-thirds vote of the Association.

Section 5. In case of a corporation the membership shall stand in the name of the company, and such company shall have the right to be represented at any meeting of the Association by any of its officers or directors, or by its regularly employed manager or superintendent, and such representative may or may not be a Class B member.

ARTHUR WILLIAMS,
President.

ARTICLE IV. — OFFICERS AND EXECUTIVE COMMITTEE.

Section 1. The officers of the Association shall be a President, two Vice-Presidents, an Executive Committee of nine members, a Secretary, and a Treasurer, who shall be elected as specified in this Consitution.

Section 2. The President and Vice-Presidents shall be elected to serve one year from the first of the month following the date of their election, and shall be members of Class A or Class B. The President shall act as chairman of the Executive Committee during his term of office. He shall not be eligible to re-election for two years after his term has expired.

Section 3. The Executive Committee shall be

chosen from among members of Class A or Class B. The first Executive Committee elected after the adoption of this Constitution shall be divided into three classes. Class one shall serve for the period covered by three conventions; class two for two conventions; class three for one convention; after which three members of the committee shall be elected at each convention to serve for three succeeding conventions. They shall enter upon their duties on the first of the month following their election.

The Vice-Presidents of this Association shall be members of the Executive Committee, and the retiring President shall, by reason thereof, be a member of the Executive Committee for the period of one year after the expiration of his term.

Section 4. The offices of Secretary and Treasurer may be filled by the same person. He shall not serve as a member of any committee; shall be eligible for re-appointment without limit; shall give a security bond in such sum and with such qualifications as the Executive Committee determine from time to time, and shall perform such duties as said committee may direct, subject to its approval.

Section 5. The Secretary and Treasurer shall be nominated by the President and confirmed by the Executive Committee. He shall serve for one year from the first of the month following the date of the President's election. He may be a member of any Class other than Class C or an Honorary Member.

Section 6. The Executive Committee shall be the governing body of the Association; shall manage its affairs; pass upon all applications for membership; the eligibility of representatives, subject to this Constitution and such special rules or regulations as may be adopted by the Association from time to time. Five members of the committee shall constitute a quorum.

Article V.—Meetings.

The annual meeting shall be held in May or June of each year, alternately in the cities of New York and Chicago, unless otherwise directed by the Executive Committee and on such dates as the Executive Committee shall determine.

Article VI.—Quorum.

Fifteen Class A members of the Association shall constitute a quorum for the transaction of business.

Article VII.—Dues.

The entrance fee of Member Companies shall be twenty-five dollars.

The annual dues of Member Companies in cities and towns of less than 20,000 population shall be ten dollars; in cities or towns of from 20,000 to 300,000 population, twenty-five dollars, and in cities or towns of over 300,000 population, fifty dollars.

The initiation fee of Class D members shall be five dollars, and the annual dues shall be five dollars.

No initiation fee shall be paid by Class C members, and the annual dues shall be four dollars.

The initiation fee of Class E members shall be twenty-five dollars, and the annual dues shall be twenty dollars.

The initiation fee of Class E members shall be five dollars, and the annual dues shall be five dollars.

All dues shall be payable in advance, and shall cover the calendar year. Any member in arrears for one year's dues shall be dropped from the rolls, and if reinstated shall pay full dues for the time during which membership lapsed, or if required by the Executive Committee shall pay again the entrance fee of his class.

Article VIII.—Election of Officers.

At an executive session to be held on the second day of the annual convention, there shall be chosen a Nominating Committee, to be composed of five accredited representatives from Member Companies Class A in the following manner:

Any accredited representative of a Member Company Class A, shall have the privilege of making nominations, and when such nominations are seconded by any other such accredited representative, that nominee shall be one of those to be voted for. Nominations in this manner may continue until a resolution shall be adopted to close the lists. After the lists are closed, a ballot shall then be taken. The accredited representative present of any Class A Member Company shall have a right of voting for five of those placed in nomination in the manner previously described. The five nominees receiving the highest number of votes shall constitute the Nominating Committee.

This Nominating Committee shall, at a subsequent executive session, bring in the names of those recommended by them for the several offices to be filled.

The submission of names by the Nominating Committee shall not, however, debar any accredited representative of a Class A Member Company from making nominations for any or all of the several offices to be filled, which nominations, if seconded, shall be submitted for election at the same time and in the same manner as those of the Nominating Committee. Whenever there are more nominees than vacancies to be filled, then, in such cases the election shall be decided by ballot. When there is no contest for office, the Secretary may be instructed by a *viva voce* vote to cast the ballot for those recommended by the Nominating Committee.

All officers, except the Secretary and Treasurer, shall be elected by ballot at the annual meeting of the Association. Vacancies in office may be filled by the Executive Committee, to cover the term until the next annual meeting of the Association.

ARTICLE IX.—PERMANENT OFFICE.

A permanent office of the Association shall be maintained in the city of New York, and shall be located, furnished, and governed in such manner as the Executive Committee may from time to time determine.

ARTICLE X.—PARLIAMENTARY RULES.

Roberts' Rules of Order shall be the governing parliamentary law of the Association in all cases not definitely provided for by its Constitution or its own rules.

ARTICLE XI.—VOTING AND PROXIES.

Section 1. A roll call shall be ordered on the demand of ten Class A members on any question before the Association. Unless otherwise ordered or specified in this Constitution, all voting shall be by voice.

Section 2. Voting by proxy shall not be allowed at any meeting of the Association, or of any of its committees.

ARTICLE XII.—AMENDMENTS.

Section 1. Amendments to this Constitution shall be offered in writing, and shall be referred, before bein gacted upon, to a committee to be elected by the Association. A two-thirds vote of all Class A members present shall be necessary for their adoption.

Section 2. Any amendment may be voted upon by the Association at the convention in which it is introduced, unless objection is made by five Class A members.

W. C. L. EGLIN,
Secretary and Treasurer.

GEO. F. PORTER,
Master of Transportation.

DUDLEY FARRAND,
Vice-President.

PROGRAM
OF THE
NATIONAL ELECTRIC LIGHT ASSOCIATION CONVENTION

Washington, D. C., June 4-7, 1907

PROGRAM OF MEETINGS.

Tuesday, June Fourth.

Opening Session, Ten O'Clock.

Convention Called to Order, By the President.

Introduction of Gen. Geo. H. Harries, Vice-President Washington Railway and Electric Company, By the President.

Address of Welcome, Hon. H. B. F. Macfarland.

President Board of Commissioners District of Columbia. Mr. Macfarland will be introduced to the Convention by Gen. G. H. Harries.

President's Address.

Announcements, By the Secretary.

Report of Committee on Progress,
Mr. T. Commerford Martin, New York.

Accidents, Mr. Paul Lupke, Trenton, N. J.

The Effect of Frosting Incandescent Lamps,
Dr. Edward P. Hyde, Washington, D. C.

Need for an Accurate Maximum Demand Meter for Measuring the True Energy of Polyphase Service.

A Discussion led by Mr. Louis A. Ferguson, Chicago, Ill.

Question Box, Mr. Paul Lupke, Trenton, N. J.

The Question Box will be presented by Mr. Lupke. Opportunity for any desired discussion will be given later in the Convention.

Report of the Executive Committee,
By the Secretary.

Evening Session, Eighty-Thirty O'Clock.

Report of Committee on Electric Light Accounting,
Mr. H. M. Edwards, New York, Chairman.

Mr. Edwards will preside during the presentation and discussion of this report.

Legal Justification for Differential Rates,
Mr. Geo. Whitefield Betts, Jr.

Recent Developments in Mercury Rectifiers,
Mr. Frank Conrad, Pittsburg.

Report of Committee on Standard Rules for Electrical Construction and Operation,
Mr. Ernest H. Davis, Williamsport, Pa., Chairman.

Report of Committee on the Fire Hazard of Electricity, Mr. C. E. Skinner, Pittsburg, Chairman.

Report on Insurance and Kindred Matters,
Mr. W. H. Blood, Jr., Boston,
Insurance Expert of the Association.

Executive Session.

Report of Committee on Membership Dues,
Mr. W. H. Gardiner, New York, Chairman.

Report of Committee to Revise Constitution and By-Laws,
Mr. Samuel Scovil, Cleveland, Chairman.

PROGRAM OF ENTERTAINMENT.

Tuesday, June Fourth.

Morning.

Automobile ride for the ladies. This will consist of a two-hour trip around Washington. The autobile will leave the New Willard from the Pennsylvania avenue side at ten o'clock.

Please obtain tickets from Bureau of Information.

Afternoon.

Special reception at the Executive Mansion by the President of the United States. Only members and guests, each wearing the Association badge, will be admitted to the Executive Mansion.

It will be necessary to leave the hotel promptly at 2:15 o'clock.

Car ride to Cabin John Bridge following the President's reception, stopping at Glen Echo. Cars will leave the F Street entrance of the New Willard.

Please obtain tickets before one o'clock from the Bureau of Information.

Evening.

Theater party (at the Columbia Theater) for the ladies— Columbia Stock Company.

Please obtain tickets before six o'clock from the Bureau of Information.

PROGRAM OF MEETINGS.

Wednesday, June Fifth.

Morning Session, Ten O'Clock.

New Developments in Arc Lamps and High Efficiency Electrodes, Mr. G. M. Little, Pittsburg.

Indefinite Candle Power Ratings in Municipal Contracts, Mr. Henry Floy, New York.
Mr. E. Leavenworth Elliott, New York.

Report of Committee to Consider Specifications for Street Lighting.
Mr. Dudley Farrand, Newark, N. J., Chairman.

Dr. A. E. Kennelly will preside during the presentation and discussion of this report.

It is expected that several types of illumination will be on exhibition, including the Magnetite, Titanium, Flaming and Mercury Vapor Arcs; Moore Tube Lighting; Tantalum, GEM, Tungsten and Nernst Lamps.

Dr. C. P. Steinmetz, Mr. L. A. Ferguson, Mr. Peter Cooper Hewitt, Mr. F. W. Willcox, Mr. V. R. Lansingh, Mr. W. D. A. Ryan, Dr. C. H. Sharp, Prof. L. B. Marks, Mr. Paul Spencer, Dr. E. P. Hyde, Mr. Wilson Howell, and others, have been invited to take part in the discussion.

Report of Committee on the Present Methods of Protection from Lightning and other Static Disturbances,
Mr. Alexander Dow, Detroit, Chairman.

Recent Developments in Protective Apparatus,
Mr. D. B. Rushmore, Schenectady, N. Y.

Electric Heating without Special Concessions from the Central Station,
Mr. C. D. Wood, Jr., New York.

The Future of the Gas Engine,
Mr. Lewis Nixon, New York.

Application of Gas Power to Central Station Work,
Mr. J. R. Bibbins, Pittsburg.

Producer Gas Engines for Central Station Work, (Illustrated by Stereopticon.)
Mr. Robert T. Lozier, New York.

The Frequencies of Flicker at which Variations in Illumination Vanish, Dr. A. E. Kennelly,
Mr. S. E. Whiting, Harvard University.

Efficiency of Various Methods of Illumination (Illustrated by Stereopticon).
Mr. E. A. Norman, New York.

Report of Committee on Electric Heating and Cooking,
Mr. James I. Ayer, Boston, Mass., Chairman.

Evening Session, Eight-thirty O'Clock.

Lightning and Lightning Protection,
Dr. C. P. Steinmetz, Schenectady.

PROGRAM OF ENTERTAINMENT.

Wednesday, June Fifth.

Automobile ride for the ladies. This will consist of a two-hour trip around Washington. The automobile will leave the New Willard from the Pennsylvania avenue side at ten o'clock.

Please obtain tickets from the Bureau of Information.

Afternoon.

Exhibition Cavalry and Field Artillery Drill at Fort Myer.

It will be necessary to leave the New Willard at two-thirty o'clock, sharp. The drill will be at three-thirty o'clock.

Evening.

Eight-thirty o'clock—Lecture of Dr. Steinmetz in the large room on the main floor of the New Willard.

Ladies are invited to attend.

Nine-thirty o'clock—Ball in the meeting room of the hotel on the tenth floor.

Music by Haley.

PROGRAM OF MEETINGS.

Thursday, June Sixth.

Morning Session, Ten O'Clock.

Report of Freight Classification Committee,
Mr. Ernest H. Davis, Williamsport, Chairman.

Recent Turbine Developments,
Mr. W. L. R. Emmet, Schenectady

Power Factor Correction,
Mr. F. D. Newbury, Pittsburg.

The Electric Automobile as an Adjunct to Central Station Load,
Mr. H. H. Rice, Indianapolis.

Some Power Experiences,
Mr. S. M. Sheridan, Detroit.

Municipal Ownership,
Mr. Arthur H. Grant, New York.

Why We Failed in a Municipal Ownership Campaign, Mr. Glenn Marsden, New York.

Italian Methods of Charging for Electric Current,
Signor Ing Guido Semenza, Milan, Italy.

Report of Membership Committee,
Mr. J. Robert Crouse, Cleveland, Chairman.

Report of Committee on Relations with Local Associations,
Mr. S. R. Bradley, Jr., Nyack, N. Y., Chairman.

Report of Committee on the Grounding of A C Secondary Circuits,
Mr. W. H. Blood, Jr., Boston, Chairman.

Evening Session, Eight-Thirty O'Clock.

Executive Session.

Report of Committee on Relations between Manufacturers and Central Stations,
Mr. Henry L. Doherty, New York, Chairman.

Report of Committee on Rates and Costs,
Mr. R. S. Hale, Boston, Chairman.

Report of Public Policy Committee,
Mr. Everett W. Burdett, Boston, Chairman.

Mr. Everett W. Burdett, Chairman, will preside, and it is expected that Messrs. Charles L. Edgar, Samuel Insull, Alex. Dow, Henry L. Doherty, Joseph B. McCall, J. W. Lieb, Jr., and Samuel Scovil will participate in the discussion.

PROGRAM OF ENTERTAINMENT.

Thursday, June Sixth.

Morning.

Automobile ride for the ladies. This will consist of a two-hour trip around Washington. The automobile will leave the New Willard from the Pennsylvania avenue side at ten o'clock.

Please obtain tickets from the Bureau of Information.

A special electric 'bus will leave the hotel from the Pennsylvania avenue side at ten o'clock and again at twelve o'clock, going directly to the Corcoran Art Gallery. In each instance it will return from the Gallery one-half hour later.

Afternoon.

A visit to Mount Vernon, going by boat. Lunch will be served on the boat, which will leave the Mount Vernon Steamboat Wharf, foot of 7th street, sharp at one-thirty o'clock. The excursion will go as far down the Potomac River as Indian Head, returning in time to reach the Washington Wharf at about six o'clock in the evening.

Evening.

Luna Park: A visit for the ladies of the Convention, escorted by members of the Entertainment Committee.

PROGRAM OF MEETINGS.

Friday, June Seventh.

Commercial or New Business Day.

Morning and Afternoon Sessions at Ten O'Clock A. M. and Two O'Clock P. M. Adjournment for Luncheon at One O'Clock.

Scope and Character of Papers and Discussion,
Mr. W. W. Freeman, Brooklyn, N. Y.

THE COMMERCIAL FIELD.

Co-operative Commercialism in the Electric Field,
Mr. J. Robert Crouse, Cleveland, Ohio.

Report of National Electric Light Association Coöperating Committee,
Mr. W. W. Freeman, Chairman, Brooklyn, N. Y.
(To be read by some member of the Committee designated by the Chairman.)

Possibilities of Commercial Development,
Mr. Henry L. Doherty, New York.

New Business. How to Get It—How to Keep It,
Mr. F. M. Tait, Dayton, Ohio

New Business Results Demonstrated in Cities of All Sizes,
Mr. J. E. Montague, Reporter, Niagara Falls.

Discussion.

"Commercial Day" papers are limited to five and ten minutes each. In the absence of the chairman's specific approval in each instance, discussion upon these papers is necessarily limited to three minutes for each speaker.

QUESTIONS OF POLICY.

Sales Policy in Combination Gas and Electric Companies,
Mr. F. A. Willard, Rochester, N. Y.

The Electrical Jobbers' and Dealers' Coöperation in Business Getting,
Mr. R. V. Scudder, St. Louis, Mo.

Coöperation of the Electrical Trade Papers in Business Getting,
Mr. F. W. Loomis, Reporter, Savannah, Ga.

Discussion:

WIRING.

How to Get the Old Buildings Wired,
Mr. F. H. Golding, Dayton, Ohio.

How to Get the New Buildings Wired,
Mr. J. Sheldon Cartwright, Knoxville, Tenn.

Coöperation of the Electric Contractor in the Wiring of Buildings,
Mr. James R. Strong, New York.
President The National Electrical Contractors' Association of the United States.

THE SOLICITOR.

Sizing Up the Territory—Preparing the Lists of Prospective Customers,
Mr. George Williams, Cincinnati, Ohio.

Qualifications of Solicitors for Different Classes of Business,
Mr. F. W. Frueauff, Denver, Colo.

How to Measure Results and Pay Solicitors,
Mr. Leon H. Scherěck, Birmingham, Ala.

Increasing the Efficiency of the Sales Force,
Mr. J. D. Kenyon, Chicago, Ill.

Value and Use of Solicitors' Handbook,
Mr. R. S. Hale, Boston, Mass.

Discussion.

Adjournment for Luncheon.

"Commercial Day" papers are limited to five and ten minutes each. In the absence of the chairman's specific approval in each instance, discussion upon these papers is necessarily limited to three minutes for each speaker.

ADVERTISING.

A Balanced Advertising Program,
Mr. Ralph Richardson, Jackson.

Advertising Results Demonstrated in Cities of All Sizes,
Mr. E. S. Marlow, Reporter, Washington.

How to Make the Most of Newspaper Advertising,
Mr. A. D. Mackie, Peoria.

Measuring the Results of Advertising,
Mr. M. S. Seelman, Jr., Brooklyn.

Value of the Service of the Advertising Agency or Specialist,
Mr. Lawrence Manning, Owosso.

Display Room and Demonstration as Business Getters,
Mr. E. R. Davenport, Providence.

New Business by Indirect Methods,
Mr. L. D. Mathes, Dubuque.

Discussion.

LIGHT.

Illuminating Engineering as an Aid to Securing and Retaining Business,
Mr. C. F. Oehlmann, Cincinnati.

Methods of Securing Residential Business,
Mr. R. W. Hemphill, Ann Arbor.

Coöperative Lighting of Streets by Merchants,
Mr. H. J. Gille, St. Paul.

Methods of Securing Sign, Window and Outline Lighting,
Mr. Homer Honeywell, Lincoln.

Discussion.

"Commercial Day" papers are limited to five and ten minutes each. In the absence of the chairman's specific approval in each instance, discussion upon these papers is necessarily limited to three minutes for each speaker.

POWER.

Methods of Securing Power Business,
Mr. Geo. N. Tidd, Scranton.

Catering to Power for Automobile Charging,
Mr. R. W. Rollins, Hartford.

Establishing Day Circuits in Towns of 10,000 Population and Under,
Mr. F. H. Plaice, New Bremen, Ohio.

Discussion.

HEATING.

Methods of Exploiting Electric Heating Devices,
Mr. T. K. Jackson, Mobile.

Discussion.

Review of Advertising (Illustrated with Stereopticon Slides), Mr. C. W. Lee, Newark.

Memorials, Mr. T. C. Martin, New York.

Report of the Nominating Committee.

Election of Officers for the Ensuing Year.

Adjournment.

PROGRAM OF ENTERTAINMENT.

Friday, June Seventh.

Morning.

Automobile ride for the ladies. This will consist of a two-hour trip around Washington. The automobile will leave the New Willard from the Pennsylvania avenue side at ten o'clock.

Please obtain tickets from the Bureau of Information.

Afternoon.

A special 'bus to the National Museum and the Corcoran Art Gallery at two-thirty and three-thirty o'clock, returning from each one-half hour later.

All sessions will open at the time stated in the program.

An electrical stereopticon will be available at all times. The meeting room can be darkened on a moment's notice, permitting the use of lantern slides for the illustration of any paper or address.

The Jamestown Exposition will be open during the Convention. It may be reached by train or a night's sail down the Potomac River and Chesapeake Bay. Delegates attending the Exposition would find it very convenient to leave Friday night on the boat, arriving at Jamestown on the following morning. A Day Boat for Old Point Comfort, Jamestown Exposition and Norfolk, may be taken at 8 A. M. on Saturday, June 8.

Plan to leave the Convention not sooner than Friday night. Friday is "Commercial Day" and may assist in reaching some of your ideals in the commercial development of your company.

In the absence of special consent of the chair, speakers should limit themselves to not more than five minutes.

The Cook and Stoddard Company, 22nd and P streets, invites any delegate to the Convention to visit its Mercury Rectifier Storage Battery

Charging Plant. In this plant there is a capacity for the simultaneous charging of ninety-two vehicles.

There will be special daily automobile service between the New Willard Hotel and the Capitol, the Congressional Library, the National Museum and the Corcoran Art Gallery. The hours of departure from the various places will appear, from day to day, in the "CONVENTION DAILY."

The Association is indebted to the Commercial Truck Company of America, 1222 Arcade Building, Philadelphia, Pa., for the loan of a new electric omnibus, which has been placed at the disposal of the Entertainment Committee. The Association badge will admit passengers to this 'bus.

Anyone desiring to visit Washington by automobile may obtain full information on this subject by addressing Mr. J. M. Stoddard, Chairman Automobile Committee, 22nd and P streets, Washington, D. C.

It is expected that there will be several interesting games of baseball on nearby grounds. The games last year at Atlantic City were amongst the most interesting features of entertainment.

The Washington Railway and Electric Company extends a cordial invitation to visit its power houses. Special guides will be furnished for any parties that the delegates may desire to make up for that purpose. FULL INFORMATION AT THE INFORMATION BUREAU.

Members desiring to play golf may secure full information and tickets of admission to the golf grounds at the Information Bureau.

CONVENTION COMMITTEES, 1907.

General Committee—Mr. Dudley Farrand, Chairman, Newark; Mr. W. C. Eglin, Treasurer, Philadelphia; Mr. John Martin, San Francisco; Mr. Henry L. Doherty, New York City; Mr. Louis A. Ferguson, Chicago; Mr. Alex. Dow, Detroit; Mr. Samuel Scovil, Cleveland; Mr. C. L. Edgar, Boston; Mr. Frank W. Frueauff, Denver; Gen. Geo. H. Harries, Washington, D. C.

Reception Committee—Gen. George H. Harries, Chairman; Mr. and Mrs. Dudley Farrand, Mr. and Mrs. Alex. Dow, Mr. W. C. L. Eglin, Miss Eglin, Mr. Arthur Williams, Mr. and Mrs. William H. Blood, Jr., Mr. and Mrs. Charles L. Edgar, Mr. and Mrs. Samuel Scovil, Mr. and Mrs. A. J. De Camp, Mr. and Mrs. W. F. White, Mr. and Mrs. Louis A. Ferguson, Mr. and Mrs. Charles R. Huntley, Mr. and Mrs. John Martin, Mr. and Mrs. Frank M. Tait, Mr. Frank W. Frueauff, Mr. Henry L. Doherty, Mr. and Mrs. W. H. Gardiner, Mr. and Mrs. N. F. Brady, Mr. and Mrs. Thomas E. Murray, Mr. and Mrs. J. W. Lieb, Jr., Mr. and Mrs. H. M. Edwards, Mr. and Mrs. W. W. Freeman, Mr. and Mrs T. C. Martin, Mr. and Mrs. Thomas N. McCarter, Mr. and Mrs. Joseph B. McCall, Mr. and Mrs. Geo. F. Porter, Mr. and Mrs. Philip Torchio, Mr. and Mrs. C. S. Shepard, Mr. and Mrs. W. J. Sefton.

Entertainment Committee—Mr. H. W. Fuller, Chairman; Mr. W. C. Allen, Mr. Philander Betts, Mr. Proctor L. Dougherty, Mr. Thomas J. Fisher, Dr. E. P. Hyde, Mr. W. F. Ham, Mr. John C. McLaughlin, Mr. J. E. Powell, Prof. Edward B. Ross, Maj. Edgar Russell, Dr. Samuel W. Stratton, Mr. R. W. Scott, Mr. Elliott Woods, Mr. Julian F. Woodwell, Mr. F. J. Whitehead.

Hotel Committee—Mr. E. S. Marlow, Washington, D. C., Chairman; Mr. E. E. Bondy, New York, Vice-Chairman; Mr. F. H. Gale, Schnectady, N. Y.; Mr. J. C. McQuiston, Pittsburg, Pa.; Mr. W. R. Huntley, Buffalo, N. Y.; Mr. Homer E. Niesz, Chicago, Ill.; Mr. C. A. Tupper, Milwaukee, Wis.; Mr. John C. McLaughlin, Washington, D. C.; Mr. W. K. Handy, Washington, D. C.; Mr. George P. Mangen, Washington, D. C.; Mr. Philander Betts, Washington, D. C.; Mr. R. W. Rollins, Hartford, Conn.; Mr. G. W. Brine, Atlanta, Ga.; Mr. Paul Doty, St. Paul, Minn.; Mr. J. J. Cagney, Montreal, Canada; Mr. Joseph E. Carroll, Beaumont, Texas; Mr. H. W. Turner, Butte, Mont.; Mr. B. W. Stephenson, Mandan, N. D.; Mr. C. H. Hodskinson, Boston, Mass.; Mr. E. F. Phillips, Detroit, Mich.

Advertising Committee—Mr. Cyril Nast, New York, Chairman; Mr. George P. Mangen, Washington, Vice-Chairman; Mr. M. S. Seelman, Jr., Brooklyn; Mr. William R. Huntley, Buffalo; Mr. Percy Ingalls, Newark; Mr. Laurance Jones, Baltimore; Mr. Frank W. Smith, New York; Mr. F. G. Sykes, Portland, Oregon; Mr. L. D. Gibbs, Boston; Mr. Frank C. Farrar, Denver; Mr. J. W. Hancock, Roanoke; Mr. Howard K. Mohr, Philadelphia; Mr. E. W. Lloyd, Chicago.

Exhibition Committee—Mr. L. E. Sinclair, Washington, D. C., Chairman; Mr. Walter Neumuller, New York, Vice-Chairman; Mr. Douglass Burnett, Baltimore; Mr. C. H. Hodskinson, Boston; Mr.

Percy Ingalls, Newark; Mr. H. C. Lucas, Philadelphia.

Committee on Engineering Plans—Mr. Philip Torchio, New York, Chairman.

Committee on Automobiling—Mr. J. M. Stoddard, Chairman, Washington, D. C.; Mr. C. D. Haskins, Schenectady, N. Y.; Mr. Frank W. Smith, New York City.

Transportation Committee—Mr. George F. Porter, New York, Chairman.

Program Committee—The President; Mr. H. W. Fuller, Washington, D. C.; Mr. J. Robert Crouse, Cleveland.

Chief of Registration Bureau—Miss Edith M. Myers.

STANDING COMMITTEES, 1907.

Committee on Electric Heating and Cooking—Mr. James I. Ayer, Boston, Chairman; Mr. H. W. Hillman, Schenectady; Mr. H. P. Davis, Pittsburg. Mr. Percy Ingalls, Newark; Mr. C. D. Wood, New York.

Committee on Rates and Costs—Mr. R. S. Hale, Boston, Chairman; Mr. Louis A. Ferguson, Chicago; Mr. Samuel Scovil, Cleveland; Mr. C. L. Edgar, Boston; Mr. Frank W. Frueauff, Denver, Mr. P. G. Gossler, New York; Mr. W. H. Gardiner, New York.

Committee on the Fire Hazard of Electricity—Mr. C. E. Skinner, Pittsburg, Chairman; Mr. A. A. Pope, New York; Mr. Howard R. Sargent, Schenectady.

Committee on the Present Methods of Protection from Lighting and Other Static Disturbances—Mr. Alex. Dow, Detroit, Chairman; Mr. Robert S. Stewart, Detroit; Mr. O. A. Honnald, Salt Lake City.

Committee to Assist in the Further Development and Prosecution of the Plans of the Co-operative Electrical Development Association—Mr. W. W. Freeman, Brooklyn, Chairman; Mr. R. S. Hale, Boston; Mr. John F. Gilchrist, Chicago; Mr. J. E. Montague, Niagara Falls; Mr. F. M. Tait, Dayton.

Freight Classification Committee—Mr. Ernest H. Davis, Williamsport, Chairman; Major A. J. Gifford, Schenectady; Mr. W. B. Everest, Pittsburg; Mr. Charles S. Shepard, New York; Mr. R. C. P. Holmes, Chicago.

Public Policy Committee—Mr. Everett W. Burdett, Boston, Chairman; Mr. Henry L. Doherty, New York; Mr. Alex. Dow, Detroit; Mr. Charles L. Edgar, Boston; Mr. Samuel Insull, Chicago; Mr. J. W. Lieb, Jr., New York; Mr. Joseph B. McCall, Philadelphia; Mr. Samuel Scovil, Cleveland; Mr. W. H. Gardiner, New York, Secretary.

Committee to Consider Street Lighting Specifications and New Methods for Street Illumination—Mr. Dudley Farrand, Newark, Chairman; Dr. A. E. Kennelly, Cambridge; Mr. Chas. P. Steinmetz, Schenectady; Mr. Paul Spencer, Philadelphia; Mr. Louis A. Ferguson, Chicago.

Committee on Electric Light Accounting—Mr. H. M. Edwards, New York, Chairman; Mr. A. S. Knight, Boston; Mr. G. W. Curran, Philadelphia; Mr. Paul R. Jones, New York; Mr. C. N. Jelliffe, New York.

Committee on Standard Rules for Electrical Construction and Operation—Mr. Ernest H. Davis, Williamsport, Chairman; Mr. Samuel Scovil, Cleveland; Mr. Louis A. Ferguson, Chicago; Mr. William Brophy, Boston, Mr. Alexander Henderson, New York; Mr. E. A. Norman, New York, Secretary.

Committee on Dues—Mr. W. H. Gardiner, New York, Chairman; Mr. Edwin R. Weeks, Kansas City; Mr. Frank W. Smith, New York.

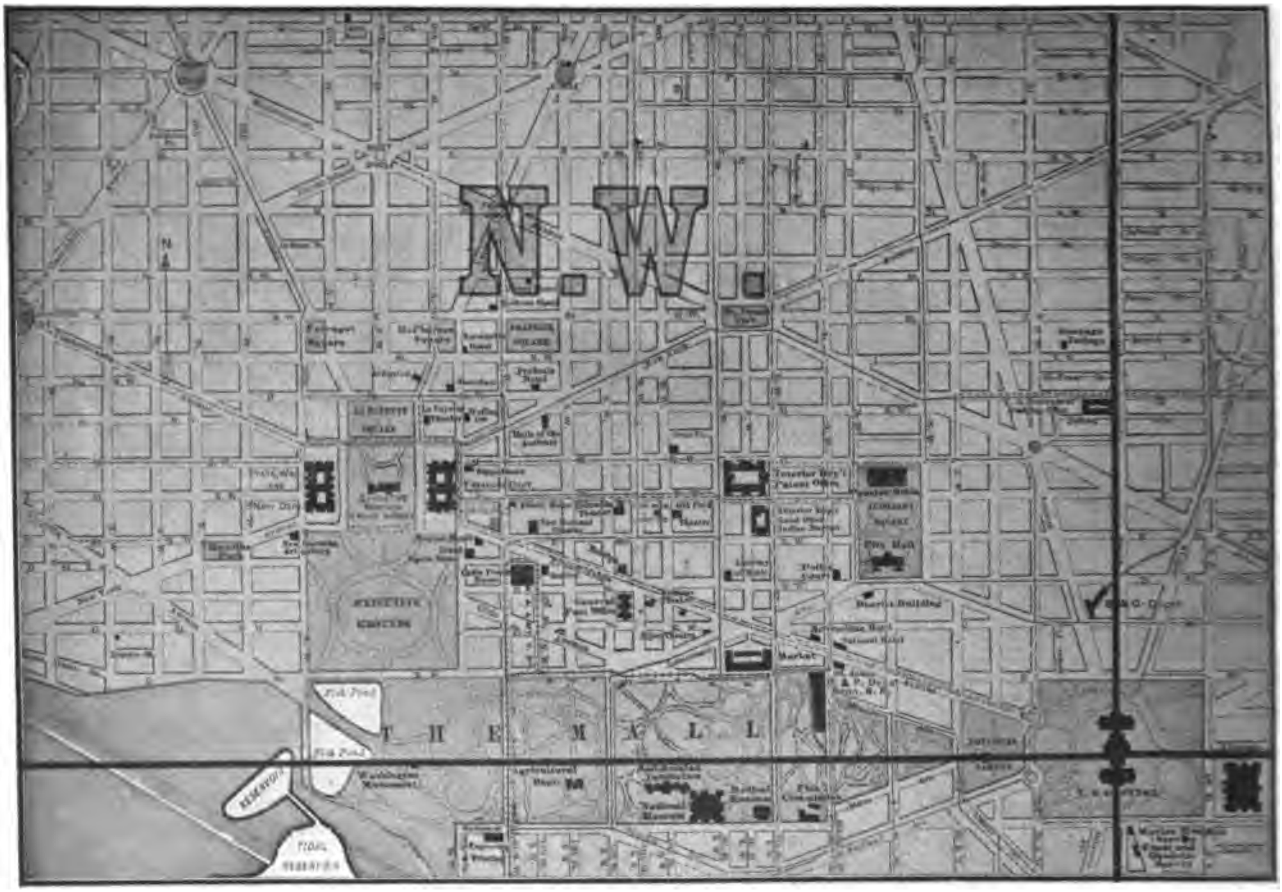
Membership Committee—Mr. J. Robert Crouse, Cleveland, Chairman; Mr. W. L. Mulligan, Springfield; Mr. Leon H. Scherck, Birmingham, Ala.; Mr. A. L. Selig, Los Angeles; Mr. Converse D Marsh, New York.

Washington—The Convention City.

This year's meeting place of the National Electric Light Association ranks not only as one of the most attractive cities in America, but as one of the most beautiful cities in the world, and is, from every standpoint, an ideal convention rendezvous. Furthermore, the members of the Association and their friends will be privileged to see the national capital at its best, when its 92,000 trees—more than are possessed by any other city not excepting Paris—are in the full glory of fresh spring foliage and the dozens of little parks, squares and plazas, scattered all through the city, are aglow with brilliant-hued flowers.

The New Willard Hotel, meeting place and head-

quarters of the convention, is admirably located with reference to the convenience of sightseers. All the theaters, the principal shops and not a few of the historic buildings and other points of interest are within easy walking distance, whereas five of the principal traction lines of the city pass one or the other of the entrances to the hotel, and afford direct communication with most of the more distant tourist meccas. The hotel, it may be explained, covers the full width of a city block, facing on Pennsylvania avenue—the famous thoroughfare between the White House and Capitol, and extending through to F street, the principal shopping district of the city.



For a majority of visitors to Washington the White House is, very naturally, a place of paramount interest. It is located two short blocks west of the New Willard. The beautiful grounds are open during all the daylight hours and certain portions of the State suite of the mansion may be inspected by visitors during the greater part of the day. At the right of the White House is a building of classic design occupied by the Treasury Department and where visitors may peep into vaults containing millions of dollars and witness the counting and handling of coin and currency by deft-fingered experts. On the left of the Presidential Mansion is the massive granite building that serves as the home of the State, War and Navy Departments, and the corridors of which are filled with models and relics that make of it a veritable naval and military museum. Facing this trio of public buildings is the park known as Lafayette Square, which contains several interesting statues and is bounded by historic houses including the house that was for years the home of Dolly Madison; the residence of Admiral Decatur, the former residences of Sumner, Daniel Webster, etc. Here also is old St. John's the famous "Church of the Presidents" where worshiped every President from Madison to Lincoln and of which Mrs. Roosevelt is now a member.

In the opposite direction from the New Willard and in plain sight up Pennsylvania avenue—though nearly a mile distant—is the U. S. Capitol. The

great white-domed building is open every week-day and visitors may inspect the legislative halls of the U. S. Senate and House of Representatives, the meeting place of the Supreme Court, etc. Directly east of the Capitol is the famous Library of Congress, which represents an expenditure of more than $6,000,000, and is admittedly the most beautiful and most elaborately decorated building in the world. While this masterpiece of art and sculpture should also be visited in daylight if possible, it goes without saying that all persons interested in electrical subjects will wish to make a pilgrimage there after nightfall when the artistic lighting effects may be seen to the best advantage.

The Government Printing Office, the largest printing office in the world, may be included in the same sight-seeing trip as that embracing the Capitol and Library and so likewise may the Washington Navy Yard, where is located Uncle Sam's great gun shop for the manufacture of naval ordnance—an industrial plant that makes extensive use of electric power. The building of the U. S. Post-Office Department where electric canceling machines and other novelties may be seen in operation, is within walking distance of the Willard, and so is the Patent Office, which proves a magnet for many visitors. The fashionable residence districts of Washington, the wide streets lined with the mansions of wealthy residents, the embassies and legations of foreign nations and the homes of statesmen and government officials, may be seen to the best advantage from automobiles—sight-seeing autos as well as touring cars for hire are available to the visitor—and the asphalt streets that are universal in the City of Magnificent Distances make such jaunts particularly enjoyable.

Two blocks south of the New Willard is located the power house which has for eight years past served as the central station of the Washington Railway & Electric Company (principal local light and power corporation), and which will repay a visit. Continuing southward one-eighth of a mile the sightseer may visit the Department of Agriculture with its beautiful gardens; the Smithsonian Institute and National Museum, both filled with rare relics; the famous Washington National Monument; and the U. S. Bureau of Engraving and Printing, where he will find 2,600 men and women busily engaged in the picturesque work of manufacturing our paper money and postage stamps.

Many of those in attendance at the convention will doubtless desire to visit the new $1,500,000 turbine generator plant of the Washington Railway and Electric Company where two 5,000-kilowatt Curtis turbines may be seen in operation, together with other equally interesting up-to-date equipment. This institution is located at Bennings, Maryland, just over the boundary line from the District of Columbia, and to reach it requires a journey of about half an hour via a city and suburban electric line. Other suburban trips that should not be omitted by any visitor are those to Mount Vernon, the home and tomb of George Washington—reached either by steamer ride on the Potomac, or by trolley—and to Arlington on the Potomac, once the home of Gen. Robert E. Lee, of the Confederacy, but now our greatest national cemetery. The trip to Arlington may readily be arranged to include a visit to Fort Myer, Virginia, an up-to-date military post where cavalry and artillery evolutions may be witnessed. Yet other enjoyable excursions involving rides of little more than half an hour from the New Willard may be made to the National Zoological Park, which contains a truly notable collection of wild animals and to the National Soldiers' Home, a model institution of its kind. The U. S. Naval Observatory located on the heights of Georgetown and the U. S. Bureau of Standards situated northwest of the city are government institutions likely to prove of direct or indirect interest to most persons engrossed with the subject of electrical power. Similarly, the headquarters of the U. S. Weather Bureau (reached by cars that pass the New Willard) will repay a visit from technical men. For persons who are interested in the application of electrical power to automobiles there are several up-to-date garages whose equipment might prove worthy of study.

Central Station Light, Heat and Power Principles

By Newton Harrison.

Central Station Design.—The design of a central station is distinguished from that of a power house in the sense that a central station is devoted to electric lighting interests primarily, and power purposes secondarily. On the other hand, a power house is entirely devoted to the production of electricity for power purposes primarily, by which is meant street railway work and lighting secondarily.

Because of this difference between the two, the laying out of one in comparison with the other, calls

for a design that is distinctive in either case. A brief outline of the requirements will appear in something like the following form:—

1st. The building, with its floors and walls suited to the particular purposes in view.

2nd. The boiler room, designed to possess sufficient capacity to do the work required.

3rd. The engine room, which is the dynamo or generator room as well, equipped to handle the machines with ease for installation or removal.

The point of interest is that it will not pay to

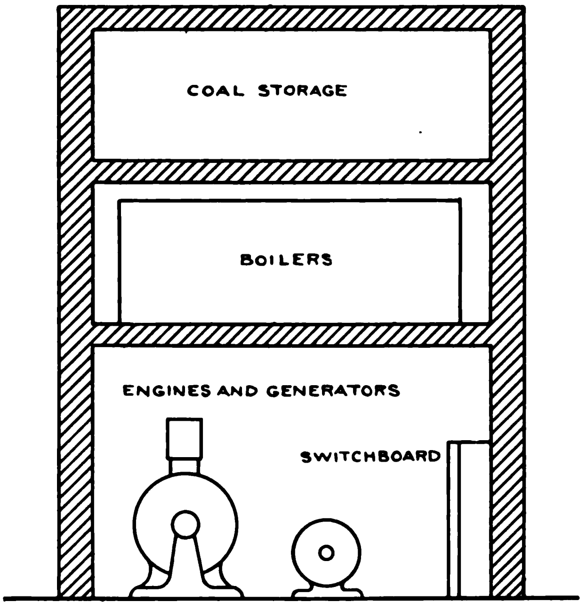


FIG. I.—A MODERN CENTRAL STATION SCHEME.

have machinery situated, Fig. 1, otherwise than on different floors. This is because of the expense for ground in large cities, where the plants referred to are generally found. Practice to-day demand either a space entirely adequate to suit the requirements of a large switchboard, or a separate room or building devoted entirely to that purpose.

Elements of a Plant.—It is not a difficult matter to enumerate the parts of a plant, at least in so far as they represent the essential elements. The cost of installation is dependent upon the value of the real estate and building, Fig. 2, on the one hand; and the value of the elements on the other hand. It is, therefore, possible to group expenses into two general classes for convenience as follows:

1st. Building, ground and what relates to the architectural and hygienic features in detail.

2nd. Equipment, and what relates to its general as well as its specific arrangement.

The details of each may be examined in the manner given, or taken up for further investigation by the architect and engineer in conjunction.

BUILDING FEATURES.

1. Character of cellar.
2. Strength and thickness of walls.
3. Strength and thickness, as well as character of floors.
4. The use of braces or steel frame construction.
5. Use of fireproofing materials.
6. Number of floors.
7. Position of the coal supply.
8. Position and number of windows.
9. Provision for the ejection of ashes.
10. Means employed to hoist and handle machinery.
11. Character of the foundation, with regard to the possibilities of vibration.
12. Materials composing the face or front.
13. Size of chimney.

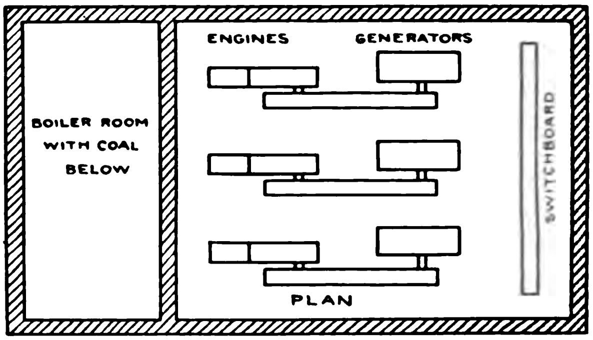


FIG. 2.—CENTRAL STATION SCHEME WHEN SPACE IS CHEAP.

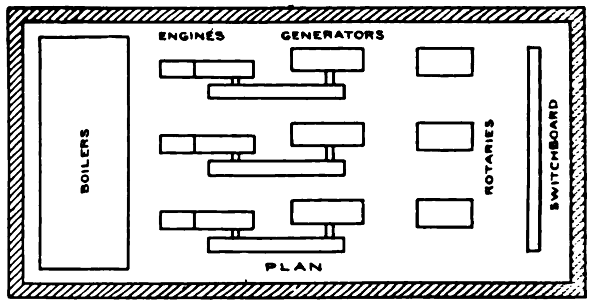


FIG. 3.—CENTRAL STATION ALL ON ONE FLOOR, COST OF SPACE NOT CONSIDERED.

STATION ELEMENTS.

1. Generators.
2. Steam engines, gas engines, turbines or water wheels.
3. Boilers.
4. Pumps.
5. Water supply.
6. Character of fuel.
7. Weight per floor per square foot.

8. Switchboard.
9. Cables.
10. Mains.
11. Waste, oil and grease.
12. Repairs.
13. Amount and character of labor employed.
14. Underground conduits.
15. Overhead lines.

The idea that prevails with respect to station design to-day, is that while economy is the ruling feature, the means of obtaining it must not be limited. By this is meant that economy cannot be obtained unless it is bought. Or, in other words, the saving along certain lines in a station is only possible if the very best of machinery is purchased. This leads to the consideration of the sources of expense in equipment and operation in a central station.

Cost of Generating Power.	*Cost of Labor.*	*Fixed Charges.*
Includes Fuel	Includes Managers	Taxes.
" Oil	" Dynamo tenders	Interest
" Waste	" Wiremen	Insurance.
" Repairs	" Agents	Depreciation
" Water	" Firemen	
	" Office help	

Cost and Charge for Power.—The cost of power to a station at the switchboard, and then its cost per kilowatt hour at any given point in the radius of operation, represents two propositions which, though related, are still indicative of differences, which practically determine the success of the station as a business proposition to a marked degree. The means of getting the power to the switchboard consists largely in its generation in the dynamos, and then its conduction to the bus-bars for distribution by means of feeders of other out-going lines.

From the switchboard, the process is one of transmission, to a greater or less extent, to the various termini constituting the consumers' taps. The waste of power from the dynamo to the switchboard may be very slight, but the waste of power from the switchboard to the termini spoken of, may be considerable in proportion. It is, therefore, impossible to fix a rate for power on the basis of the cost at the switchboard. There, it may cost anywhere from one-half a cent more or less, to two or three cents per kilowatt hour. Whereas, from the switchboard to the various points of consumption, it may, unless care is taken to make it otherwise, cost as much again. Drop, in outside lines or cables, and too many heavy bills for repairs, are essentially a part of the general cost of generating and distributing power in such instances.

Methods of Charging for Power.—Two general methods, widely known, by which power is paid for are either the meter system, by which a customer pays for what is used at a certain rate per unit of power; or the flat rate system, which means a charge that does not vary much per month, six months, or year.

There are other methods than these, of advantage to the consumer, if conditions in his case are pro-

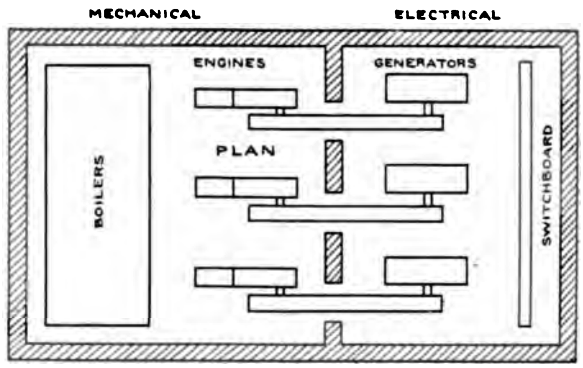


FIG. 4.—PLAN OF STATION WITH ENGINES AND BOILERS TOGETHER AND BELTS EXTENDING TO DYNAMO ROOM.

pitious. Whatever they may be in general, the point of importance, is that the burden must never be made to fall unreasonably upon any particular class of customers, otherwise the chances of financial failure and law suits will be always imminent.

The fixing of charges in such a manner, that when more than a certain amount per month is used, a reduction in the rate per unit takes place, is

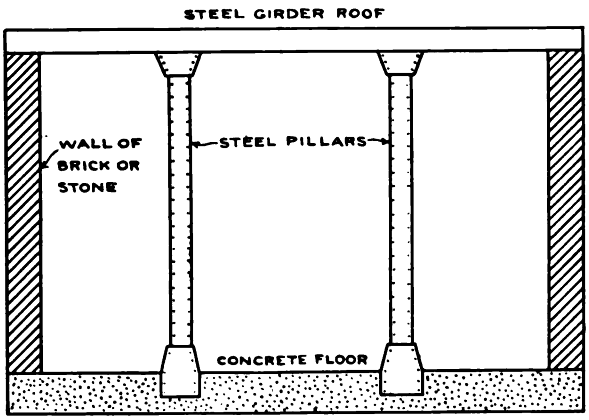


FIG. 5.—ELEMENTS OF A STEEL FRAME STATION MADE FIREPROOF.

practiced in England as well as this country, to some extent; though as stated, the rates depend upon the nature of the agreement, and this must be

made so as to be *absolutely* profitable to the station, or deficits will inevitably result at the end of the year.

The practice of charging more for the same power, if used at a time when the station is most heavily loaded, is not entirely what it should be; not so much on account of the system, as due to the manner in which the lights are burned on a flat rate basis, under these conditions.

Floor Design for Station.—Large plants and small plants call for an observation of the same general principles, in the layout of the floors. As has been stated, the fact that everything is not on one floor is largely due to the cost of ground, Fig. 3, in a large city. It would be better, in many respects, to have it that way: *i. e.*, all on one floor if possible.

There are, therefore, designs to be made to suit conditions with belted plants, Fig. 4, direct connected plants, and turbine equipments. Where water-power is used, the floor design, with respect to the apparatus employed, differs again. The point of importance, irrespective of the size of the plant, is to have each class of machines and apparatus grouped together.

Position of the Parts.—Briefly speaking, the boilers should be placed next to the engine room. The coal should be readily obtained for consumption without too much time being wasted and too much handling being necessary. The switchboard must be accessible, but not necessarily situated in the generator room. In some instances, the rating is based upon the kilowatt capacity per square foot of floor space, in order to institute comparisons. The various illustrations typify cases, which have been followed, Fig. 5, to some extent in practice. It may be added, that the use of high tension power, would necessitate the segregation of death-dealing parts to a safe place. A correct design in such an instance, would mean either a separate building for the sake of safety, or the use of guards and screens tc avoid fatality in the handling of the apparatus.

Prepared for THE CENTRAL STATION by Colin P. Campbell, Attorney.

Liability for Injury from Electric Shock When Wiring Was not Done in Accordance with Regulations and Was Without a Permit

Plaintiff had his store wired for electricity and the wires belonged to him. Defendant did not own the wires in the building, but owned the wires carrying the current of electricity to the building and owned the meter outside. Subsequently, plaintiff employed a private contractor to put in an extension to the wiring already in the building. This was done without permission of the city authorities and without inspection by them. The injury was caused by taking hold of the electric light bulb which had been placed on the extension and at the same time touching the covered wire which led to the bulb. The hand on the bulb came in contact with the metal part of the fixture. Defendant had put the bulb on the extension, but there was no fuse in the rosette from which the light was suspended, nor in any part of the extension. The ordinances of the city required an inspection and permit before installing electric plants. Upon these facts the court said:

"In our opinion, upon the special findings made by the jury, the plaintiff would be entitled to retain his verdict if there was no error in the admission of the evidence or in the instructions upon

which those findings were made. But we are of opinion that there was such error.

"There was, to say the least, evidence upon which the jury might have found that the plaintiff, in putting into his cellar the wire and appliances for a portable light, violated sections 9, 10 and 11 of the ordinances of the city of Lowell, in that he failed to notify the inspector of wires of the intended extension before the work was begun and did not obtain a permit for such extension, and did not comply, in making the extension, with the rules and regulations of the national board of fire underwriters; and that this conduct of the plaintiff was the cause of the accident which happened. In view of the penalty imposed by section 14 of the ordinance, the presiding justice rightly ruled that the plaintiff could not recover if he had thus acted in violation of the ordinance and such violation had contributed to the accident. Brunelle v. Lowell Electric Light Corporation, 188 Mass. 493, 74 N. E. 676. But as bearing upon the latter question he permitted the inspector of wires, against the exception of the defendant, to testify that in a case like this, where wires were already installed and there was simply an extension made, it was not his practice to require an application to be made and a written permit to be obtained before the current was turned on, but to make such requirement only where there was a new installation; that in the majority of cases where the work was exposed, he did not go to examine the premises, but relied on his notice; that if he thought there was any question about the contractor or the premises he would make it his business to get there; that he knew Hinckley, the contractor, who did this work, and that he stood well in his business. He further testified at considerable length to the same effect. That this evidence was introduced to excuse the plaintiff for not having seasonably made application and secured a permit from the inspector is shown by the fact that the judge in his charge called the attention of the jury to the testimony and instructed them that in determining whether the plaintiff was negligent in not having obtained a permit, they might consider the practice of the inspector at that time not to grant permits, if they so found; and also allowed them, in passing upon the question whether the plaintiff's violation of the ordinance contributed to the happening of the accident, to consider whether the inspector, if he had received the proper notice, would have inspected these wires, fuses and apparatus, and have required them to conform to the standard of the rules and regulations of the national board of fire underwriters. In our opinion this was erroneous, and was prejudicial to the defendant; for the special findings of the jury may have rested entirely upon this testimony of the inspector of wires.

The usage and practice which the inspector testified that he had adopted were certainly contrary to the terms of the ordinance, and were unlawful. The jury should not have been allowed to speculate upon the question whether the inspector, if he had received proper notice from the plaintiff, would have neglected to perform his duty. This was wholly an immaterial question. Jones v. Holden, 182 Mass. 384, 65 N. E. 808; Pickering v. Weld, 159 Mass. 522, 34 N. E. 1081; Abbot v. North Andover, 145 Mass. 484, 14 N. E. 754; Commonwealth v. Perry, 139 Mass. 198, 29 N. E. 656; Cutter v. Howe, 122 Mass. 541. The recognized principle that in dealing with ancient instruments and transactions, where doubtful words are used, where the purpose and intent are obscurely expressed, the acts and conduct of the parties, immediately following, are to be regarded as the best expositors of the meaning intended. (Cambridge v. Lexington, 17 Pick 222, 230), is inapplicable here. And see, further, Geyser-Marion Gold Mining Co. v. Stark, 106 Fed. 558, 45 C. C. A. 467, 53 L. R. A. 684; Consolidated Coal & Mining Co. v. Floyd (Ohio), 38 N. E. 610, 25 L. R. A. 848.

"The testimony of the inspector of wires to his opinion that it was not the duty of any person other than himself to enforce in the city of Lowell the provisions of the ordinance which has been mentioned, ought not to have been received. It was for the court and not for the witness to construe the ordinance." Brunelle v. Lowell Electric Light Co. (Mass.), 80 N. E. Rep. 466.

The result of this decision is that the defendant was not liable, even though the current sent over the wires was excessive, inasmuch as it did not install the wiring and so neglect to put in proper safety devices when the wiring was not done under the rules of the city which electric company had a right to believe would be obeyed by anyone doing wiring.—Ed.

Validity of Exclusive Grants (Concluded)

We have examined the leading cases in this field and have found that while in most instances the

courts inclined against exclusive grants and either construe them as not being exclusive or hold them invalid, still it has become apparent that these will be held valid under some circumstances and in some states. The more sensible rule, although we must confess that this is not the one concurred in by the weight of authority, is that a city or other municipality having the right to say what uses a private company may put a street to, may, when it has given permission to a certain company to use the street, forbid another company to do this. This is doubtless, when seen in this way, the general rule of law. Beyond question a city may prevent any and all light or power companies from using its streets. The only question is, may it agree with the company which is given the first franchise that it will not grant another franchise to another company. Upon this point, as we have said, the weight of authority beyond question is against the validity of such contracts. The principal ground for those decisions being that such exclusive grant tends to create a monopoly, effects a restraint of trade and is antagonistic to the general free trade spirit of our jurisprudence. Other cases have, however, taken the view which seems to us the most logical, that inasmuch as the municipality may forbid any or all companies from using its streets, it may agree with one company that a franchise will not be granted to another, especially if thereby the city acquires an advantage which may serve, as the lawyers say, as a consideration for such contract by way of exclusive grant.

Upon this point of general validity of the exclusive grant there are some quite recent cases which may well be examined. It must be confessed that the tendency of the later cases is almost unanimously against the validity of exclusive grants, the fundamental idea seeming to be that the public good demands that there shall be ample opportunity for competition in the business of supplying municipalities and their citizens with electric light and power. Thus it has been held in a late case in Florida, Capital City Light & Fuel Co. v. Tallahassee, 28 So. Rep. 810, decided in 1900, that the fact that a city is given power to grant a franchise for municipal lighting does not authorize it to grant an exclusive franchise nor does a general power to provide for the lighting of the streets of the town or to provide for the improvement, regulation, extension and opening of streets, lanes and avenues and to provide for the removal of encroachments therefrom, confer any authority upon the city to grant any exclusive privilege to use the streets of the city for the purpose of laying pipes or erecting poles and towers for the furnishing of electric lights. Consequently, when all the power which a city has to grant a land letting franchise is conferred in terms like these, it cannot grant an exclusive privilege for the use of the streets by an electric light and fuel company. It is further held by this case that the general incorporation act under which the plaintiff in that case was organized and which conferred upon any corporation organized under it, exclusive privileges for the purposes of its creation for the term of twenty years did not add anything to the powers of the city with reference to the right to grant exclusive powers and privileges. It was said that this section does not purport to confer any power on municipal bodies or to aid or supplement any grant of powers by municipalities. It merely purports to grant rights from the legislature to the corporation organized under the act. It was further claimed in that case that a prior grant by an act to subsequently repeal to the predecessor of the plaintiff was operative to confer exclusive privileges upon the plaintiff. The answer of the court to this contention was that it would not construe such grant in any other manner but strictly against the exclusive privilege claimed and would therefore hold that the repeal operated to take away the exclusive rights of the predecessor of plaintiff and consequently of plaintiff itself. The general rule laid down was, that all grants of exclusive franchises are to be strictly construed against the grantee and nothing passes thereby unless clearly intended. It was also held that even though the city had the power to grant an exclusive franchise, it could not permit the franchisee, as was attempted in the Tallahassee case, to defer the construction of its plant and the placing in operation of its mains and lines for an indefinite period as until such time as the business anticipated would pay 8 per cent. interest on the investment. To a similar effect is the Clarksburg Electric Light Co. v. Clarksburg, a West Virginia case, reported in 35 S. E. Rep. 994. In that case it was held that an exclusive grant was beyond the authority of the municipal corporation and is void. In this case it was attempted to show that an exclusive grant by a municipality is a contract within the meaning and intent of the federal constitution to protect contracts from impairment, and that therefore inasmuch as the city agreed impliedly by granting an

exclusive right that it would not subsequently grant similar rights to another party, it was restrained by the fundamental law of the United States from granting a similar franchise to another company. The Supreme Court of W. Virginia, however, in 1900, the same year in which the Florida case was decided, declared in no less unequivocal terms against the validity of an exclusive grant and said the grant was void, that it was not therefore unsupportable as a contract and did not warrant the application of the contract clause of the federal constitution. The Supreme Court, however, went further in favor of the lighting company than was done in the Supreme Court of Florida, and held that the city could not permit a trespass by the second franchisee upon the rights of the predecessor of the first franchise and consequently the court would, under the contract clause of the federal constitution, prevent the city from allowing such trespass. The court, however, said that neither the fact that the company had acted upon the faith of its exclusive grant nor that the city had in essence gratified the grant by buying electricity from the franchisee to light its streets, would give the franchise validity as an exclusive conveyance. The theory of the court being that inasmuch as the exclusive grant exceeded the power of the municipality, consideration for it or recognition of it could not put life into it. The result of these cases then is, that an exclusive franchise is of no more value than a general franchise so far as protecting the rights of the franchisee from encroachment by a subsequently organized company. While we are compelled to take issue with the doctrine that the contract is enforcible if upon consideration, nevertheless, if we can see that the city lacks authority to say who shall and who shall not occupy its streets with poles and wires, the conclusion is inevitable that such exclusive franchise is beyond the authority of the municipality.

Suction Producer Gas, Its Formation and Economy as a Means for Generating Power in the Modern Producer Gas Engine

By J. H. Clapperton.

In 1881, at the New York meeting of the British Association for the Advancement of Science, the late Sir Frederick Bramwell, a prominent member, made the prophecy that in fifty years the steam engine would have been replaced by the gas engine. This prophecy was based on the performance of a small three horse-power gas engine exhibited at the meeting in connection with the first Dowson power gas producer.

Since that time, and particularly in the last few years, many important changes and improvements have been made in the gas engine as well as in the gas producer, bringing producer-gas forward to become an important factor in the modern industrial life. Yet, it would be venturesome to subscribe, today, to the memorable prophecy of twenty-six years ago, even in full view of the fact that the gas engine is speedily gaining ground on its more wasteful competitor.

Moreover, it may be seen, that what more than anything will likely prove to be the saving factor in the future career of the steam engine, is, curiously enough, its very wastefulness, because just as long as conditions prevail in that the waste during the transformation of heat-energy into power, the latent heat in the exhaust steam can be continuously and fully utilized to advantage, just so long is the steam engine likely to find its peculiar field of usefulness. But whenever the main or exclusive object is the generation of power from available fuels, then the gas engine may be depended on to be the more efficient motor. To be sure, the heat in the exhaust gases from the gas engine can also be utilized for heating purposes, to a limited extent; either by heating from the gases directly or indirectly, by absorbing the heat value into hot water or steam. However, as the gases contain very much less heat value than the exhaust steam from a steam engine of the same power, they can of course not be counted upon to give but a small percentage of that obtained from the steam engine, but whenever a limited amount of steam is required, as for instance in the case of flour milling, then that supply can readily be obtained.

That, in principle, the transformation of heat into power is more efficient in the gas engine than in the

steam engine, is recognized, and readily proven by the established absolute efficiency of a perfect heat engine expressed by the formula:

$$\frac{T_1 - T_2}{T_1}$$

T_1 and T_2 being absolute initial and final temperatures of the working charge.

By inserting in the above formula the available extreme temperature-limits, the numerical value of the absolute thermal efficiency becomes:

for the gas engine $\dfrac{2160 - 560}{2160} = 74$ per cent.

for the steam engine $\dfrac{872 - 560}{872} = 36$ per cent.

That is, assuming that the temperature of the working charge would be raised in the gas engine cylinder, as it normally is, through compression and combustion, from a temperature of 100 degree Fahr. to an initial temperature of 1,700 degrees and expanded in the cylinder until its temperature again becomes 100 degrees, then the total efficiency of the heat-transformation would be 74 per cent. Similarly, the assuming that steam is raised in the boiler from water of a temperature of 100 degrees Fahr. to the initial temperature 412 degrees (corresponding to a pressure of 250 pounds) and that it is expanded in the engine-cylinder the entire range down to the temperature at which the cycle started, 100 degrees, then the total efficiency of the heat-engine becomes 36 per cent.

However, these ideal efficiencies of respectively 74 per cent. and 36 per cent., based on the assumption of a perfect heat-transformation, can in reality never be obtained, and the object of their deduction here is simply to show the comparative ultimate limit for the economy of the gas engine and of the steam engine, due to the difference in the range of temperatures between which they operate. But should we reduce the above percentages to about one-half of their ideal value, then they will represent, fairly, the maximum thermal efficiencies that has been obtained in reality, or for the gas engine 37 per cent. and for the steam engine 18 per cent.

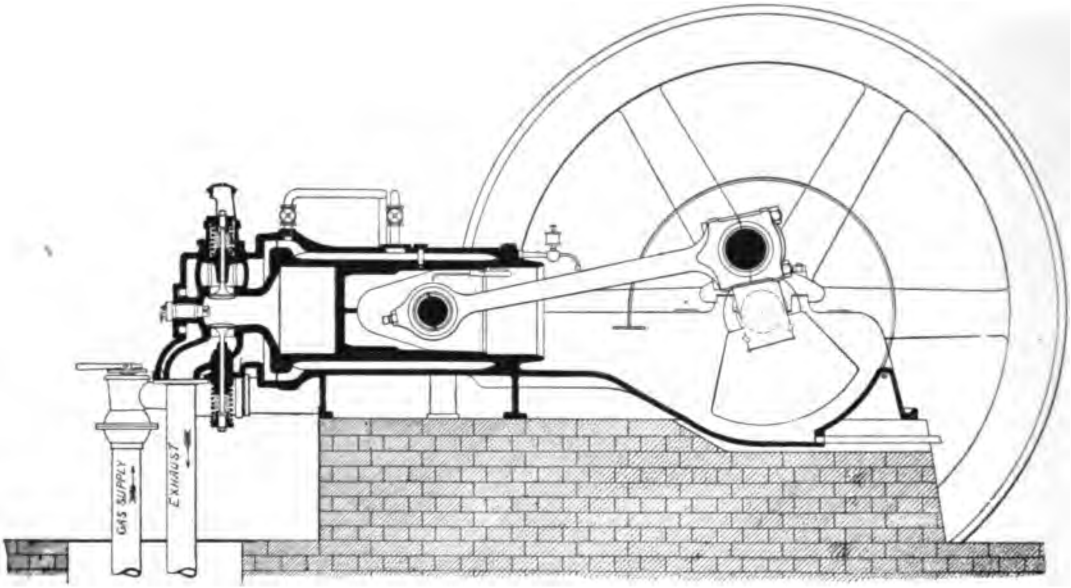


FIG. 1.—CROSS SECTION OF THE MUENZEL GAS ENGINE.

The combined efficiencies of the producer-gas engine and producer and of the steam engine and boiler will, of course, be somewhat less than the percentages just quoted, which apply for the engine alone, and, as the process of gasifying the fuel in a good type of producer returns readily 80 per cent. of the heat-value of the fuel, while an efficient boiler

returns only a maximum of 70 per cent., the total useful effect obtainable from the coals consumed will be for the gas plant 29 per cent. and for the steam plant 13 per cent. That is, the total returns in power from the heat-value of the fuel are in the gas plant fully twice that of the most efficient steam plant, such a one, we may say, as includes in its equipment a compound or triple expansion condensing engine. Furthermore, the efficiency of the gas engine varies very little with the power, size or type of the engine, whereas the efficiency of the steam engine varies considerable; on which account it will be found that the actual coal consumption per horse-power is in the gas plant often materially less than one-quarter of that of the average well-equipped steam plant.

The chemical reactions on which the operation of the gas producer is based are very simple, and should be carefully considered by anyone wishing to obtain unfailing and efficient results in its manipulation. The first reaction, taking place in the lower part of the fuel bed is the combustion of carbon, C. into carbon dioxide gas, CO_2, the second is the reduction of this gas into carbon monoxide gas, CO, as it passes up through the incandescent fuel bed, and the third is the decomposition of steam in contact with carbon of a high temperature, resulting in the formation of hydrogen, H, and carbon monoxide, CO. The first reaction is expressed chemically by the formula:

$$C + 2O = CO_2$$

The information conveyed by this formula may be expressed by stating; that for the complete combustion of one pound of carbon there is required 2 2/3 pounds of oxygen, and the resulting carbon dioxide gas will weigh 3 2/3 pounds. During the complete combustion of each pound of carbon there is generated heat to the entire heat-value of the fuel, or about 14,500 heat-units.

The second reaction taking place in the producer is expressed by the formula:

$$CO_2 + C = 2CO.$$

That is, the previously formed 3 2/3 pounds of carbon dioxide takes up one pound more of carbon, forming 4 2/3 pounds of carbon monoxide, or per pound of carbon consumed we obtain 2 1/3 pounds of carbon monoxide gas.

The first two reactions in the gas generator, in combination commonly called incomplete combustion, results in the combustion of carbon to carbon monoxide gas, and during the process there is developed heat to the total amount of about 4,500 heat-units, or less than one-third of the heat-value of the fuel; this heat will appear as sensible heat of the gases and of the fuel bed. The carbon monoxide gas formed can at any time after it has left the furnace be made to again combine with oxygen to the same amount as that which it already contains, in doing which it will generate more than twice the heat developed at its formation in the furnace, or about 10,000 heat-units.

The proportion of oxygen to nitrogen, N, in the air being in the ratio of one pound of oxygen to 3.35 pounds of nitrogen, and as for each pound of carbon consumed there has been introduced in the furnace 2 2/3 pounds of oxygen, the 2 1/3 pounds carbon monoxide gas obtained from each pound of carbon must therefore be diluted by 4.46 pounds of nitrogen. But, nitrogen being an inert gas and carbon monoxide of low calorific value, it is evident that the gas mixture resulting from the first two reactions of the process in the generator, and which is the main constituent of producer-gas, must be a lean fuel-gas.

In the power gas-producer, the object is to operate combustible gas of as high heat-value as possible, but any sensible heat is not required for the process, excepting to the amount necessary to maintain the temperature of the furnace at such a degree that the formation of gas takes place readily. All that is required, therefore, for the formation of combustible gas in the producer is to supply it with the amount of air only that is necessary for the combustion of carbon to carbon monoxide gas. As, however, during this gasification sensible heat is generated to the amount of 4,500 heat-units per pound of coal and as only part of this heat, about 2,000 heat-units are carried off with the gases, or dissipated through radiation, there will be a surplus of heat, about 2,500 heat-units per pound of coal consumed, that must be carried off from the furnace in order not to overheat the same as the process of gasification proceeds. This surplus of heat can be utilized in a most effective and desirable manner, simply by introducing steam in the furnace.

The circumstance that steam is subject to decomposition in its constituent elements, oxygen and hydrogen, when in contact with incandescent carbon of sufficient high temperature, gives cause to the third reaction in the gas generator, which is expressed by the formula:

$$H_2O + C = 2H + CO.$$

That is, each pound of steam, when heated to a high temperature in presence of carbon, will liberate 1/9 pound of hydrogen, and the 8/9 pound of oxygen which it contains will combine with 2/3 of a pound of carbon to 1 5/9 pound of carbon monoxide gas. It will be seen by the formula for this reaction that in the gasification of carbon by means of steam, no inert nitrogen is introduced in the furnace, contrary to the occurrence in case that air is employed, and as the nitrogen, which dilutes the resulting gas, is of no value as far as the heat-value of the gas is concerned, it is evident that the more oxygen that can be obtained for the combustion of carbon by decomposition of steam, the richer in heat-value will the generated gas be. However, as for the decomposition of each pound of steam there is required to be supplied heat to the amount of 6,800 heat-units, which is absorbed into the hydrogen liberated, and, as for each pound of carbon burned to carbon monoxide gas only a limited amount, about 2,500 heat-units, is available, it is evident that not more than about 0.36 pound of steam can be decomposed per pound of carbon, without coaling the furnace unduly.

0.36 pound of steam yielding at its decomposition 0.32 pound of oxygen, which combines with 0.24 pound of carbon to carbon monoxide, we may say, that somewhat less than one-quarter of the total carbon can be gasified by steam, using for the decomposition the surplus heat from the incomplete combustion only. The weight of hydrogen realized will be one-eighth of the weight of steam decomposed, or 0.04 pound per pound of coal gasified.

If a certain per cent. of the carbon dioxide gas, at first formed in the generator, is not reduced by the incandescent fuel bed to carbon monoxide, but is allowed to escape with the fuel gases, then a greater amount of heat will be available for gasification of steam and for the formation of hydrogen, resulting in a gas in the same proportion richer in heat-value. It is generally the case that some carbon dioxide will be found in the producer-gas. In fact, it has, through experiments, been found impossible to reduce the last 4 to 6 per cent. of the carbon dioxide, excepting at extremely high temperatures and slow rate of gasification. A suitable amount of moisture must, therefore, always be supplied for decomposition and for the absordption of the surplus heat in the liberated hydrogen, as otherwise there will be a loss incurred on the account that the gases will pass off hot, and the sensible heat be dissipated at the subsequent coaling of the gas. To much steam must, however, not be admitted, as this will have for effect to unduly col the fuel bed and to superheat, instead of decompose, the steam which will subsequently be condensed in the cooling process.

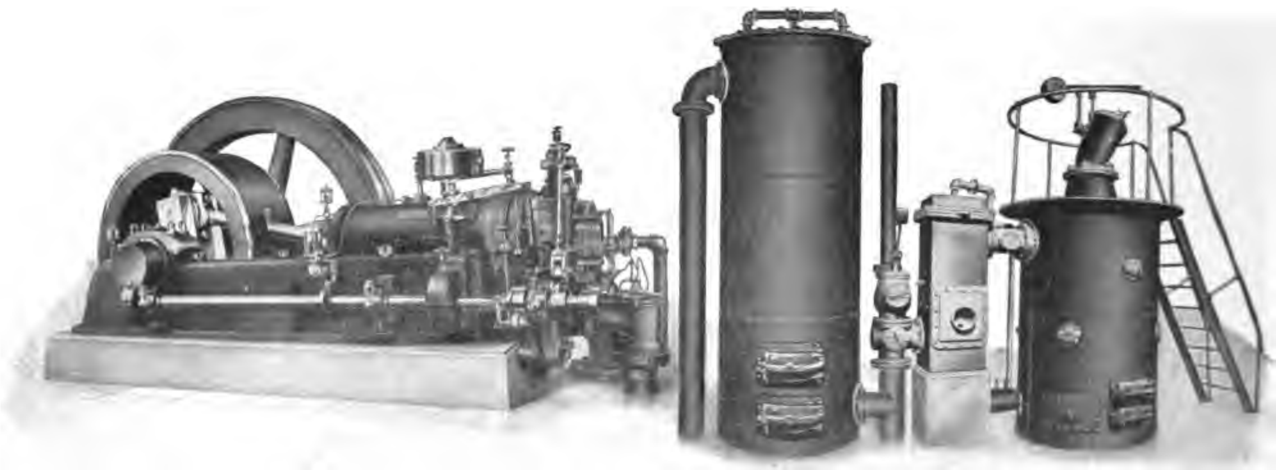


FIG. 2.—MUENZEL SUCTION PRODUCER GAS PLANT.

The percentage of fixed carbon, moisture, volatile matter and ash in coals varying considerably, it is evident that the amount of steam required to be supplied for different fuels must also vary to the same

extent. In practice, it is generally found that an anthracite suction producer requires 0.3 to 0.4 pound of steam per pound of coal gasified, and that it gives a gas, normally of a heat value of about 135 heat-units per cubic foot, of the average composition as follows:

		Per cent. volume.	Heat value per cu. ft. in heat-units at atmospheric pressure and 60° F.
Carbon dioxide	CO_2	2.5	0
Carbon monoxide...	CO	28	96
Hydrogen	H	9	31
Marsh gas	CH_4	9	10
Nitrogen	N	59.5	0
			137

The actual heat-value obtained in the gas is, thus, 87% of heat-value of the fuel, or if some waste of fuel through the grates, and other minor losses, are taken in account, we may say that the actual efficiency of the producer is 80 to 85 per cent.

From the preceding detailed account of the processes taking place in the gas producer, it may appear a rather difficult matter to control the various conditions that are required for an even and continuous formation of gas. This is, however, not so. A moderate amount only of intelligent attention to the fire will keep it in a condition to permit the products of combustion to flow freely over the entire area of the incandescent fuel bed, which is one of the essential requirements for obtaining good gas. As to the adjustment of the proper amount of steam to be admitted to the fuel, this takes readily care of

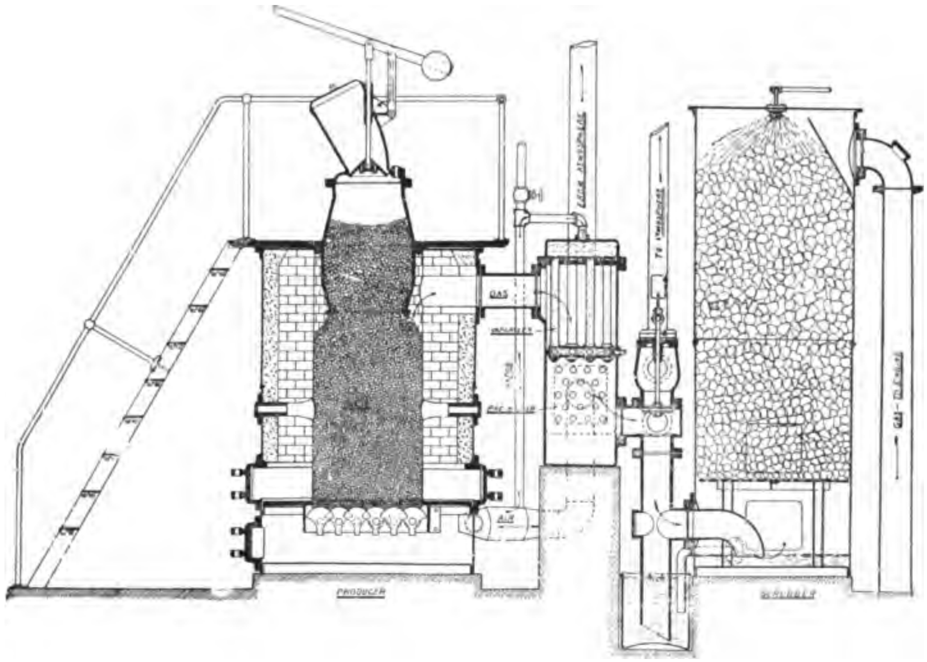


FIG. 3.—CROSS SECTION OF THE MUENZEL SUCTION PRODUCER AND SCRUBBER.

The heat value obtained per pound of fuel gasified will be:—

	Heat units.
In the carbon monoxide gas	10,000
In the hydrogen reclaimed from the heat of gasification	2,500
Additional heat obtained if 1% of hydrocarbons are present in the fuel	100
Total heat value	12.600

itself in a well-constructed apparatus, because the simple requirement, that the vapor supply be increased as the sensible heat of the fuel bed increases, is automatically filled by the tendency of the greater heat of the gases passing through the vaporizer to generate and supply a more plentiful allowance of vapor to the ash pit.

The construction of the suction gas producer, the type most frequently used at present for power pur-

poses, may be seen by the engravings, Figs. 2 and 3, which are typical illustrations of the well-known Muenzel suction gas producer, built by the Minneapolis Steel & Machinery Co. It is shown in a detailed sectional view in Fig. 3. The producer consists of a cylindrical air-tight steel shell, provided at the proper height with a rocking grate, and is lined above the grate-level with a substantial fire-brick lining. At the top is a cast-iron feeding hopper and charging bell and below this the magazine in which the fuel is preheated by the gases, before it descends upon the incandescent fuel bed.

The gases generated in the producer are discharged through a change-valve into the scrubber, in the smaller sizes, and into the separate vaporizer, in the larger sizes. The vaporizer in the smaller sizes consists of a steel pan forming the upper part of the producer body, but in the larger sizes it is found preferable to use the form shown in the illustration (Figs. 2 and 3). This vaporizer consists of a proper number of water-tubes, connecting a steam-header and a waterleg, placed in a suitable gas flue which conducts the hot gases from the producer, through the change valve, into the coke scrubber. In this gas flue are also arranged heating tubes for pre-heating the air supply which is drawn from out-doors to be supplied to the ash-pit. The change-valve affords an outlet for the poor gases that are formed in the producer when blowing up and starting the fire. The scrubber, which has for object the cooling and cleaning of the gases on their way to the engine cylinder, consists of a large cylindrical steel vessel filled with coke over which water flows from the strainer nozzle above, while the gases ascend slowly from below and are, due to the large contact surface between them and the water, effectively freed from any dust or tar that they may carry over from the producer. After the gases have passed the coke scrubber, they are, sometimes, when generated from certain tarry and less suitable fuels, carried through a saw-dust purifier for abstracting the last traces of tar. This is, however, not necessary when running on fuel of ordinary quality, but the gases are generally carried from the coke scrubber direct to the expansion tank and engine.

The expansion tank is simply a gas-tight vessel placed close to the engine for storing some volume of gas, thereby counteracting the pulsations in the gas line that in other cases would be noticeable, due to the periodical suction of the engine piston. The expansion tank serves also the purpose of effectively draining off any water that, in the form of vapor, may be carried with the gas.

The two-cycle engine, in the beginning of the gas-engine era promising much, has more and more given way for the greater simplicity and compactness of the four-cycle engine. Even disregarding the greater complication of the former type of engine ,and considering only the fact that in it the fluid velocity of the admission and exhaust gases are about eight times as great as in the four-cycle type, with consequently greatly increased fluid friction-losses, it can readily be expected that the mechanical efficiency of the two-cycle type of engine should be considerably lower than that of the four-cycle type. That actually such is the case, has also been satisfactorily proven by numerous records from gas-engine tests.

The Muenzel Producer Gas Engine is of the single acting four-cycle type for smaller or medium power and of the double acting four-cycle type for large power.

The single acting type is particularly suitable for engines of 25 to 160 horse-power in single units and for twice these powers for two engines connected in parallel to one shaft. The four-cycle double acting type, in single or double units, is recommended for power requirements above those mentioned.

Fig. 1, representing a longitudinal section of the Muenzel Gas Engine, shows a very simple and compact construction in which the various requirements for a successful service have been adequately filled

The governing of the Muenzel engine, as in most the modern engines, is accomplished by throttling a charge of constant mixture. Different methods of governing have been proposed from time to time, as for instance, the varying of the gas mixture for different loads, the changing of the point of ignition in combination with the throttling or varying of the cut-off of the gas. All these methods have appeared very promising at first, but have failed to effect any marked advantage in the realization of a higher efficiency through the greater complications they involve.

Outside of the "hit-and-miss" governing, which has been found to cause serious fluctuations in the speed of the engine, any of the common devices for governing the gas engine may, in connection with a suitable fly-wheel, be relied upon to give a very close regulation, which is most important in connection with certain kinds of service, such as flour milling, electric light service, etc.

The Central Station

ST PAUL BUILDING,

220 BROADWAY, - - - NEW YORK.

TELEPHONE, 3831 CORTLANDT.

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Central Station Two Decades Ago

Two decades ago, the cynic would say, there were no central stations. But he would be wrong, for at that time they were recognized as the beginnings of a great industry. One point, that cannot escape the attention of the thoughtful and well-read man, is that it was necessary to wait for the generator to show signs of certainty of action. However productive electric lighting seemed to be, and however sanguine, the early promoters of the electric lighting of homes and cities were, there enthusiasm could not make the dynamo regulate, run coal, be sparkless and operate without grounds and short circuits.

To-day it does all of these things; in fact, it does much more, for it will go far beyond its accredited quota of work without signs of an imminent catastrophe.

The central station would have been where it is to-day, twenty of more years ago, had the dynamo been ready. It was not, and for that reason progress was delayed, as in all probability history will show it is now being delayed, though we cannot say where or how with certainty. Two decades ago, however, both in Germany, England and France, electric lighting was more or less established. In our own country, it was not showing as many of the signs of a brilliant future as in France. This country seemed above all the leader of the procession. But with improvements in manufacturing facilities, and a recognition of the fact that we could do as well as others if we only tried, the lamp of Edison appeared on the scene, Brush brought forward his arc lamp, the arc and incandescent systems awoke to life, and central station work really began.

The making of insulated wire, developed rapidly into a great industry. It was not only the dynamo that fell into the hands of earnest, intelligent, adaptable men, but the various elements of practice existing at the time or created for the purpose required.

In this sense, twenty years ago was the scene of a more productive activity in some respects than to-day, for fundamental appliances were being made, and they have only been improved upon since. At this hour, when a convention is to be held, which promises so much of general good in this great field, a glance at the past is in good time. Gigantic, as have been the strides in central station work, the future seems as full of promise as the past. The conventions of ten or twenty years to come, will probably show that at least, if not greater progress than is even now anticipated.

Street Lighting

One of the police commissioners of New York stated publicly, that he thought an arc lamp was quite as good as a policeman, and certainly cost much less. He was referring to the night of course, and in addition, pointing out the necessity for brightly lit streets.

Although criminal statistics would probably tend

to show that much of the crime committed on the public highways at night, is attended with less risk in badly lighted than brightly lit streets; yet the fact that streets are not supplied with a greater quantity of light is a matter that the municipality has the privilege of attending to and answering for, at the same time.

Were the problem of effective street lighting left entirely in the hands of the central stations, the solution would be apparent almost immediately. The idea that a city or town can save anything by dark or dimly lit streets, which are a menace to the safety of the public is peculiarly short-sighted, to say the least.

The technical difficulties are of trifling importance in comparison with those appearing in the way when legislative action is about to begin. Politics have, to a large extent, been responsible for the lack of light in many streets of large cities. The curious fact that some of the worst streets are often the worst lit, is evidence in itself of the need for combined action, if not in any other form, at least in that of the way of suggestion from lighting authorities.

A demand should issue from the public that the streets of New York be rated at night for lighting, at a certain light per square foot. Where arc lighting preponderates, the candle feet from the foot of the pole can be readily calculated, and in this manner the areas lit up known in round figures. The use of illumination curves for this purpose, would be the means of satisfying any critic as to the amount of light available for the street surface.

In some thoroughfares, the stores at night are filled with such brilliancy that the street is illuminated in consequence. The amount of light supplied by the municipality is not up to the standard in such a case, the public as described, actually lighting the street to a large extent themselves.

The error at present in vogue, in a great city like New York, which also expresses deplorable backwardness, if not ignorance, on the part of its officials entrusted with its lighting, is the continued use of gas lamps.

The old-fashioned lighter still plies his vocation in a live, progressive, supposedly up-to-date city like this great metropolis. Something is wrong in the light of such persistent disregard of the city's needs. No one would deny that one of its greatest at least, is plenty of intelligent street lighting.

Economy Through Consolidation

Efficient business management is the underlying foundation, in all cases, of successful central station lighting. There have been instances of stations failing to pay, which did not lack business, yet floundered in the financial morass of indebtedness, until placed in a receiver's hands. Under new management, these stations have almost inevitably developed new powers. Profits were not only made to appear, but old debts paid off until the balance sheet was clear once more. In a certain way, the central station is one of the most complex of business propositions. It is complex because of the features of manufacturing and selling that it represents. Any business which is essentially characterized as an industrial or producing system, yet which offers its goods directly to the public without the intervention of the traditional middle-man, is harder to run until well established, than one which deals with the jobber, and washes its hands, so to speak, of the consumer.

The strange thing is that many manufacturing planth have their products contracted for, long before they appear. In cotton, wool and silk mills this practice is, to a certain extent, noteworthy. But the argument in this case would naturally be, that the large spinning mills or manufacturing concerns of other orders, doing the same thing, do not want to be bothered with small stores or the sale of small pieces of their products. A roll of goods is no more trouble to sell than a small part of it, and they are right in so speaking of the transaction. Yet in certain specific cases where manufacturers of articles of a staple character, are to be noted, the deal is made by means of advertisements, directly with the customer. The advertisement is, therefore, the shop window where the goods may be exhibited for sale. Or the use of stores may be part of the business system, as is frequently the case in addition to the use of advertisements. In either case, the manufacturer is put to considerable trouble and must manifest considerable skill, to keep his stock moving, his profits in the bank, and the public aware of his improvements or changes in style or quality.

The central station is in many respects, fundamentally a manufacturing plant, whose objective point is the sale of its product directly to the public. It suffers from one disadvantage in comparison; that whereas the ordinary manufacturer can sell outside of his city and State and cover in fact a

large territory, the particular case of a central station is that of a manufacturer with a limited territory and limited custom to draw from.

It has been necessary to develop special economic methods in order to meet some of the severe conditions of business, presented by the sale of electricity as stated.

The processes involved in the sale of current are complex, because of the educational, as well as the commercial features that present themselves. The struggle that results when more than one small lighting company, with an insufficient equipment attempts to control the lighting custom is fierce, and frequently useless. For that reason, in addition to a great variety of others that need not be mentioned, there is found in consolidation advantages that are widespread. They are of benefit to the consumer naturally, because of the more uniform service he obtains. They are of the advantage indicated to the lighting company, because of the higher efficiency of operation.

It is hardly necessary to go very deeply into the advantages of consolidation where conditions actually call for it. The point to the public vision is not efficiency but advantage. They care very little about the perfection of the inner mechanism. Their interest lies largely with the profit they themselves gain from it. It should be one of the features of such consolidations that the public appetite is satisfied as well. An announcement that because of gains to the parties entering into the proposition the public also will have their innings, would do much to awaken more confidence in its advantages. A bird's-eye view of the situation would quickly convince a broad-minded thinker that adverse legislation on these grounds would never be necessary.

Electrical Conventions

Without it being necessary to refer directly to conventions denoting any particular event or period in the history of an organization, a few words on the electrical convention, as a general proposition, may prove of sufficient interest at this time of the year, to awaken a keener appreciation of its value.

Within less than a generation the organizations which are stamped as distinctively electrical, have come into being. Their functions are perhaps better known to-day than then. Their widespread influence has become a noted fact, and in consequence their power for the dissemination of knowledge approaches closely to the usefulness of universities.

The electrical convention is, as its name implies, a meeting in convention of the allied members or delegates of an association representing a common purpose. The electrical convention is particularly useful, in that it always bears the stamp of newness. There are new inventions, new methods, new principles perhaps, and new points of view, which at a convention are not only brought to light, but discussed until, as a rule, even the least attentive find a thought or two taking hold which was not there before and might never have otherwise appeared.

There is a distinct advantage, due to the means thus represented, for getting professional friendships on a firmer basis. There is an exchange of opinions, illustrations, ocularly or otherwise, of many forms of mechanism, and an opportunity provided for the discovery of what is best to use of what is new, as well as of what is old.

Conventions in this sense, offer enormous advantages, which have been the real basis of their successful continuance. They are held by all the great interests of the United States, and in consequence add effectually to the direct growth of the particular industries they represent. It may not have been noted as much in the past, as it has been to-day, that a democratic spirit of the most unique character permeates these aggregations. In the old days of the merchants' guilds, and other industrial associations of a purely European origin and place, the convention was unthought of. Fairs were occasionally held, as they are now, on a large scale, by the collective industries of a nation. But the assemblage of a great class by themselves, from all parts of a great continent, speaks highly of the influence wrought by what is called a convention. To electrical people they have become indispensable, and it would not be difficult to show that the national advantages on the whole, from not one, but them all, are becoming greater each year.

The least that can be said about an electrical convention is, that it is the scene of intense activity of an educational, commercial, social and generally utilitarian character. There is evidently not much else to say, yet at least this can be added, that it is just such ideas as this which, when crystallized were the prime movers, the most efficient of all forces in opening up the possibilities of a specialized branch of industry to the financial, as well as the technical world.

CURRENT IDEAS

For Furnishing More Light, Heat and Power from Central Stations

Business Getting Methods

By E. A. Mills

From the numerous articles on the subject of business getting for electric light companies which have appeared in the technical press during the past year, the fact has been strongly brought out that to assure success to any marked degree- specialization must be made; that is, departments must be formed covering each individual line. The one in charge must be a thoroughly practical and well-informed man in the particular line in which he deals, and should combine system and business ability to a marked degree. Not much has been said about the men who compose such departments or the method under which they are educated or the system adopted to assure the best results. It is not the purpose of the writer to go into this subject to any great length or detail, but simply give the outline of the methods used by the company, with which he is connected and for his particular business, namely, signs and arc lamps.

Solicitors for this kind of work need not necessarily be technical men, although a technical training would not be amiss in handling certain questions involving the proper layout of systems of illumination and economical operation. Really the first requisite of the solicitor is hustle and push, and together with this personal appearance and manner of address. Too much emphasis cannot be put on the matter of personal neatness in every detail, as it is well known that a man who shows personal care of himself will always gain an audience sooner than an untidy person. Punctuality in keeping appointments counts greatly, and never forget the prospective consumers's name, for nothing is more embarrassing to all parties concerned than this. Once having interested the prospective customer never give him up until he signs his name to your contract. Such are the cardinal points for the solicitor to bear in mind.

As to the systems, first the territory to be operated in should be portioned off as nearly equal as possible from a business standpoint. This prevents confusion, and is the only real way to start aright. A canvass of the territory is made taking down the name and address of every person who would be likely to use the apparatus you wish to dispose of. These names are given to the Follow-Up Department, and a series of letters sent out; each letter is accompanied with a return postal which the prospect may send in should he desire to have an agent call and give further information.

The canvass being completed the agent selects a likely neighborhood and begins operations by seeing all prospects personally. If no deal is consummated at the first call, he leaves either his card or a postal for the man to mail him after he has time to thoroughly consider the proposition offered. A list of these calls is made out by each agent after his return to the office in the afternoon. In the morning these are gone over with the agent by the manager of his department and note taken of all such cases as are likely to become customers. A record is kept of these and frequent calls made until the case is closed. These daily reports are kept on file for future reference for both the manager and the agent, and further serve as a record of the expense incurred in securing business as the incidental daily expenses are noted thereon. Each man has also a binder in which is kept the mail which comes to him. This correspondence remains here until a settlement is made of each case. Every agent is instructed to keep at his man and never let up until a final disposition is accomplished. The more difficult the prospect is to approach the more it is impressed upon the agent to persist. The customer who has his prejudices against the public service corporations is met with logical argument and good humor, and the results obtained from these methods of procedure is astonishing. Each prospect is carefully looked after in every detail and this little attention works wonders. Each agent should call at his office during the day to receive such instructions or urgent cases as may be on hand.

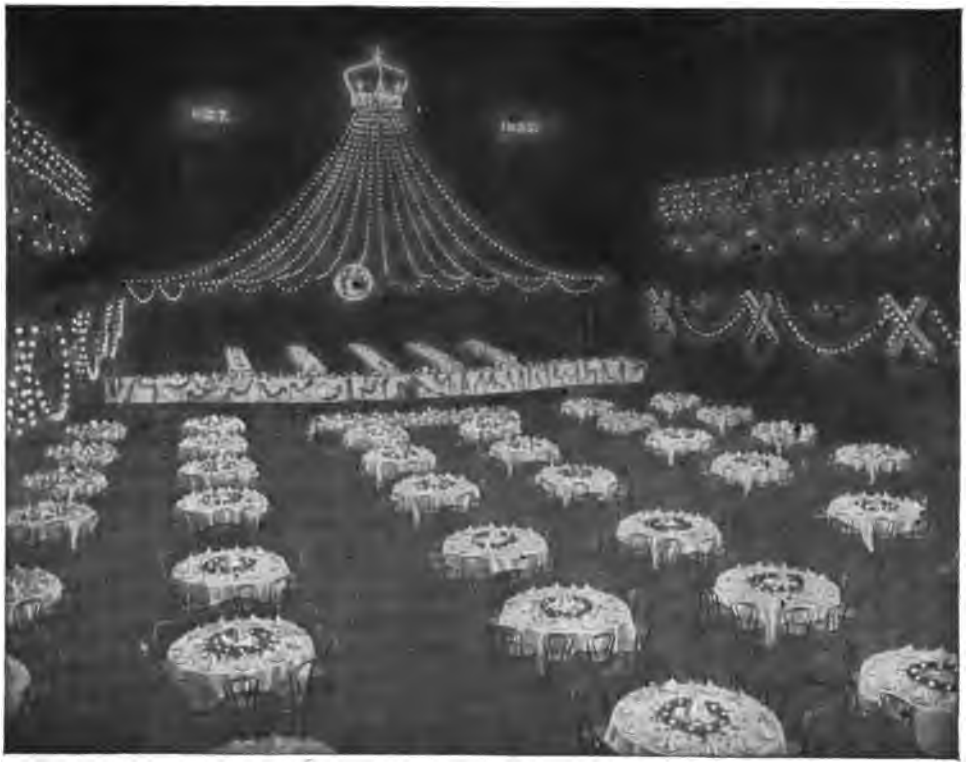
A spirit of rivalry should be established between the agents. This results in greater effort to secure new business and overcome the lead gained by an opponent or makes a record which it will be hard

for others to overcome. In order to foster this feeling, weekly as well as monthly reports are made up and kept for ready reference and inspection. Besides this a chart is made out in a more graphic way, say in the shape of an automibile race—each agent represented by a machine, and the distance from the start measured by the amount of business done. This little device is sure to bring results. The main essentials for the agent as pointed out above are push and energy, and for the manager, system, and a thorough understanding of each agent and his work.

Developing a Demand for Electrical Decorations and Displays

By K. Cameron.

Why is it that central stations in reaching out for new business overlook the application of electricity for decorative purposes? It is not because they are unwilling to avail themselves of every possible avenue for the consumption of electricity. This indifference towards electrical decorating is due primarily to the fact that they fail to appreciate the numerous opportunities that exist for securing business of this character thus causing them to belittle the extent and value of this particular electrical field. They also fail to realize that electrical decorations and displays are from one point of view advertisements for them. No other method will bring the merits of electric lighting to the attention of the public so forcibly and so attractively. In short electrical decorations stimulate and encourage the demand for electric lighting.



ELBLIGHT DECORATIONS IN SYMPHONY HALL, BOSTON.

Furthermore the failure of the central stations to take advantage of the opportunity afforded in decorating for an increased use of electricity, was due partially to the lack of materials that would meet the requirements of electrical decorating, and

partially because of the scarcity of information on the securing and carrying on of this class of business. In the past central stations have been seriously handicapped when carrying out installations of this character because the only materials at their disposal were not adequate and adaptable to the requirements of electrical decorating. These materials were not only inartistic and inconvenient to handle, but they were also a source of endless trouble and annoyance. With all these handicaps it is not surprising that the central station manager avoided the mere suggestion of electrical decorations.

With the advancement that has been made in electrical appliances and methods within the past few years have come improvements and new appliances in the field of decorative lighting, so that to-day by the use of these new appliances that are specially intended for and admirably adaptable to decorative lighting, all the limitations encountered under the old methods will be done away with. It is now possible for the central station manager to approach his customers on the subject of electrical decorating with perfect tranquillity and with the assurance that the work may not only be done quickly and well but with little or no difficulty. The most notable advance in the electrical decorating field has been through the medium of the Elblight System, a combination of lamps equipped with pin terminals which may be inserted rapidly and readily into special flexible twin Elblight cables and as easily removed. The numerous advantages of this system for decorative lighting are at once apparent.

It is of course plain that central stations must have the proper materials if they hope to successfully encourage the use of electricity for decorating. These materials should make pissible the installation of electrical decorations at short notice. They should eliminate entirely or to a great extent the necessity for preliminary preparation. The materials should be easy to install and easy to remove besides being clean and convenient to handle. They should be so thoroughly insulated themselves that porcelain or other insulators can be done away with and the work of supplemental feeding reduced to a minimum, and still be within the limits of perfect safety. The materials should lend themselves readily to the carrying out of a wide variety of electrical effects and to being used on several occasions without waste or the need of repairs. Moreover the appliances should be such that their use will not mar or deface anything with which they may come into contact, and finally the effects produced should be pleasing to the eye and conform to all the requirements of what constitutes artistic decoration.

There are two avenues open to the central station for promoting and developing the use of electricity for decorations. The first of these is the regular or periodic events that take place in their territory, including anniversary occasions, balls, banquets, fairs, etc. Under this head comes amusement parks and roof gardens. The second covers special or irregular affairs such as conventions, reunions, centennials and old home weeks, exhibitions, carnivals, etc. On these occasions electrical decorations may be of a public or private nature and may involve the use of anywhere from fifty to fifty thousand lights. Department stores with their annual spring and fall openings, their special sales and their Xmas holiday displays are examples of affairs in the first group. At these openings considerable decorating is done and during the Xmas holidays there is hardly a store of any size that does not go into decorating on an elaborate scale. To department stores particularly an artistic electrical decoration on these occasions is invaluable and the store decorator is always ready for suggestions for displays of this character.

To keep track of these affairs a coming event file should be used. This consists of one folder for each month of the year and one for each day of the current month into which are filed for attention notices of the various affairs from two to three months ahead of the date on which the affair takes place. The file for the current month should be used for distributing in daily rotation the affairs to be held in that month which have not been disposed of, or which are filed forward for attention at some special date. At the proper time the customer should be sent a letter calling his attention to the facilities of the central station for furnishing electrical decorations and this letter should be followed by a call from a solicitor with photographs or other data.

When approaching a customer on the subject of electric lighting, whether for illuminating or decorating, his attention and interest is more easily secured and maintained by combining with its presentation on strictly commercial or utilitarian lines an appeal to his sense of the artistic and beautiful. To approach a customer on this basis is to follow the line of least resistance. A man who would hesitate to spend trifling sums for reasons of utility

will quite often be found willing to spend ten times as much to gratify his love for the artistic either at his home or at his place of business, and considers his enterprise well repaid by the favorable comments that it excites.

After the first few installations have been made the demand for electrical decorating will increase rapidly. Starting a customer with an electrical decoration involving but few lamps, he will soon develop a desire for the use of electrical decorations on every possible occasion and on a larger scale. His neighbors and his personal and business associates, not to be outdone, will emulate his example. This is noticeably true among cities where each one tries to outdo the other in the extensiveness with which the streets are illuminated on public occasions.

There is no denying that there is something extremely attractive about an electrical display and the user of them realizes this at once whether the display is for some special affair or for increasing the patronage of his establishment. Then, too, electrical decorations are susceptable to such a variety of effects that they never become monotonous through sameness. After a short campaign the central station will have a large and constantly increasing demand for electricity for decorating.

Customers who use electrical decorations are more easily induced to increase their use of electricity in other directions. The appeal to their artistic sense has been complete and successful and they can readily see the advantages of an increased application of electricity for lighting purposes.

A stock of material sufficient for caring for any ordinary demands for electrical decorations should be kept on hand. Where installations involve the use of large quantities of decorative materials than central stations possess, these additional materials can be secured at reasonable rental rates and on favorable terms from the concerns that have specialized in this department of electricity. With the ability to procure the proper appliances on attractive terms the development of the electrical decorating fields by the central station is made a simple and a pleasant proposition and the development of this field will bring not only increased revenues for central stations from this use of electricity, but it will stimulate an interest in everything electrical because it has made the use of electricity attractive and a pleasure.

MONTHLY REVIEW OF THE TECHNICAL PRESS

Notes on Turbine Troubles

By G. Nevil-Thomas.

These notes are not written with any idea of going systematically into all the troubles to which a turbine is heir, but they cover a few of the many which have happened in the writer's knowledge.

On starting up a turbine at any time, it cannot be too emphatically impressed on those responsible, that there is a strong necessity for properly flushing the bearings either by the hand pump or the power driven pump. The writer has seen drivers flush the bearings with a hand pump and then allow one

or two minutes to elapse between doing so and getting the turbine away.

Oil should continue to be pumped not only as long as the machinery is stationary, but until the speed reaches 10 per cent. of full speed, because, if the pump is driven by gearing from the rotor, it will not perform its duty efficiently until this speed (approximately) is reached.

Quite recently a turbine which had been running was shut down for a few minutes. The driver then flushed the bearings and allowed it to stand for another two or three minutes. The machine was then got under way, and it had not been running more than a few minutes before the blades were stripped. On examination it was found that the bearings on both ends of the turbine were run out through over-heating due to want of oil at the start.

Another trouble which may be taken as being one of extremely rare occurrence, is due to dirt coming over from the boilers. Even in the best cared for machinery, dirt is liable at times to come across from the boilers and make its appearance in the turbine. In many cases, however, instead of passing through the turbine and condensers into the air pump discharge, it is stopped by the blades themselves.

A small amount of dirt cannot only considerably impair the efficiency of the turbine, but it can also reduce its output considerably. In addition to this, it has the effect of creating a difference of pressure between different points of the rotor, with a result that the rotor itself is coninually being forced against the end thrust bearings.

In one case so considerable was this pressure that the metal on the dummy glands was turned completely off, worked its way under the spindle of the rotor, caused it to spring, and stripped five expansions on the turbine both on the stator and rotor.

Another point which, whilst repeatedly written about, engineers constantly neglect until it has been forced upon them by experience, is the fact that it is unsafe to start up a turbine until the shaft has been properly and evenly heated. If a machine has been started up without being heated, the shaft is pretty certain at the time to be bent, this bending being due to unequal temperatures in different parts.

Should the machine be started at such a time, it will be found that in certain instances, generally speaking towards the middle expansion, the blades will be touching. With an even temperature produced by warming up the turbine before starting, the shaft regains its straightness.

It is perfectly true that for months the turbine can be started continually without causing any noticeable trouble in this direction, but it is certain in course of time to cause disaster. It happens in some cases that this touching may be going on for some time without any notice being taken, or any ill result becoming prominent, but that is no reason for neglecting precautions.

Another trouble with high-speed turbine sets develops itself on the generator side.

Some manufacturers make it a practice to insulate one of the bearings on the alternator side, the reason being that, owing to the field of the rotor being magnetically out of balance, a difference of potential arises between the two ends of the shaft. If one bearing is not insulated, the circuit is closed through the two bearings of the rotor and the base of the machine. The result is an electrolytic action between the shaft of the machine and the bearings. The effects appear to be of two kinds: either the white metal is completely run out, or else the bearings remain sound and the shaft becomes badly pitted over the whole surface. The pitting is continuous and uniform, and gives the shaft the appearance of having been standing for a long period in strong acid or of the shaft having never been turned up at all.

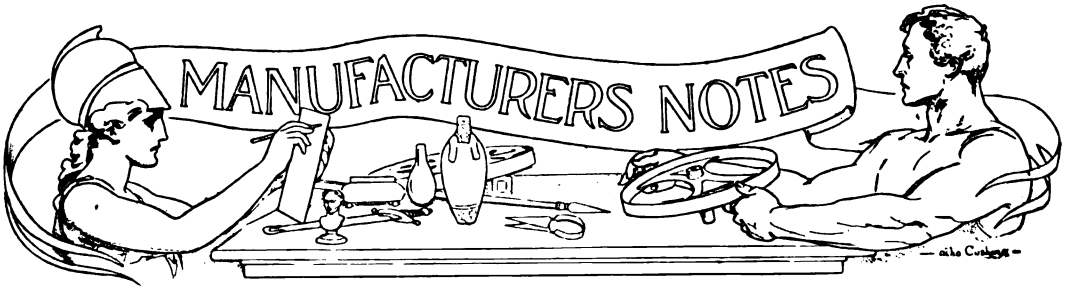
The writer has seen the shaft coated with pitmarks which must have been more than 1/64 in. deep. It was so bad that it was a matter of astonishment that the bearings had not run out through over-heating. As a matter of fact, the bearings were in perfect condition.

Another source of trouble, which also is by no means peculiar to turbines, is the trouble due to bad oils. Power station engineers would find it safer to use oils recommended by manufacturers of the turbines which they, owing to the necessity of constantly experimenting and testing, have found to be most suitable for the turbine at the lowest possible cost.

Turbine oils form a very considerable item in the expenses of a station, as even a unit of, say, 1,000 horse-power, may use as much as 60 gals. of oil, which, at the price of 3s. 6d. per gal., amounts to £10 to £12. The temptation, therefore, to cut down the cost price of oil is great, but, if given way to, without extreme carefulness in testing both chem-

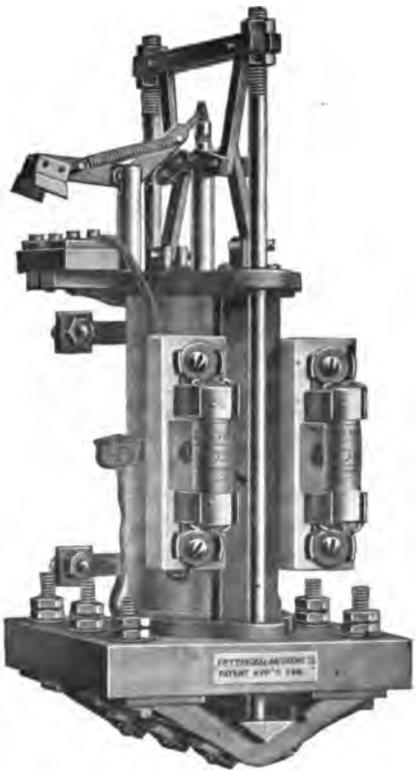
ically and by experimental use, will cause disaster in some form or other.

That there are numbers of other troubles in connection with turbines may be true, but each of the above has, within the writer's knowledge, cost money which might well have been saved if the knowledge had been forthcoming before, instead of after, the event.—*London Electrical Review.*



Remote Control Switches for Direct and Alternating Current

Light and motor control from convenient points, in mill and auditorium wiring schemes, usually necessitates the use of some form of remote control switch, or of a cumbersome and expensive direct control method, in which heavy feeders are carried back to the switching point. In installations where the former method of wiring is used, the Type D-2 switch, manufactured by Pettingill-Andrews Co., of Boston, Mass., is an absolutely reliable device.



In construction it is extremely simple, all parts being self contained, the main frame being an iron casting which forms, with the armature, a closed magnetic circuit for each coil. The movable members of the switch consist of laminated brushes equipped with auxiliary spark break, so that the switch will never fail to operate nor will it even hesitate through any roughening of the contact points due to constant use or abuse; it is very compact, and the terminals are so located that it permits of a neat method of connection in either wire or bus-bar construction. All parts of switches of the same capacity, including the coils, are interchangeable. The latter are form wound, and the switch may be changed for direct or alternating work by substituting the proper coils.

The method of operation is extremely simple, motion being transmitted from the armature to the switch arm through a double lever toggle which, when the armature has *fully completed* its *closing motion,* locks the switch firmly closed and simultaneously breaks the energizing circuit, through the closing solenoid. The switch is held closed without the assistance of the current carrying parts, and if the closing impulse is for any reason not sufficiently strong to entirely close the switch, it will instantly open by gravity, rendering the danger of a continuing arc due to an improperly closed switch an impossibility—a most important point in an automatic device. The opening coil, when energized, trips the

lock of the toggle and the switch opens by gravity at the same time, automatically breaking the energizing circuit through the opening solenoid.

Weston Electrical Instrument Company, of Newark, N. J., are meeting with splendid success with their portable multimeter, a new form of electrical

measuring instrument, which possesses a very wide range of usefulness in the measurement of electrical quantities.

This instrument serves the purpose of a direct-current voltmeter, milli-voltmeter, ammeter, mil-ammeter, ohmmeter, ground detector and wheatstone bridge. The mil-ammeter consists of a Weston type wheatstone bridge, a battery of twelve silver chloride cells, and an indicating instrument with detachable shunts. The calibrated scale of the instrument has 160 divisions, with the o placed at ten divisions from the end, so that when the instrument is used as a galvanometer in connection with the bridge, both positive and negative deflections may be observed.

The shunts are made of Weston patent alloy, having practically no temperature co-efficient, reducing the possible error in this connection to a minimum.

Their bulletin No. 6 illustrates and describes more fully this valuable little instrument, which should be in the engineer's office of every central station.

The Western Electric Company are about to issue their 1907 edition of their Supply Catalog. This will be a large volume of 700 pages, and will list everything of any importance in the electrical line.

The Supply Catalogs which have been gotten out by the Western Electric Company in the past few years, have been greatly in demand by dealers and those interested in electrical supplies all over the country, because, while the catalogs were primarily gotten up to furnish a complete list of all material handled by that company, they have at the same time always endeavored to embody such features of general interest to the electrical trade, as would make this publication a thing to be looked forward to anxiously as a desirable adjunct to the usual amount of catalog literature used by purchasing agents all over the United States and Canada.

The edition for this year will be much more complete and instructive, however, than any which has heretofore been published by the Western Electric Company, due to the fact that the Western Electric Company, starting in the first of the present year, have instituted an entire new organization in their advertising department. The advertising department has been placed in charge of Mr. Howard M. Post, who had previously successfully handled the advertising for the Kellogg Switchboard and Supply Company, who are manufacturers of telephone apparatus; also the Quincy-Manchester-Sargent Company, manufacturers of railroad supplies and machinery. Mr. Post was also associated with the Lord & Thomas Company for some time. It is understood that Mr. Post is instituting numerous new systems in advertising, such as have never been utilized before by that company, and that their results so far are highly satisfactory.

Dossert & Company, of New York City, manufacturers of the only officially approved solderless wire connectors, have recently gotten out a special connector for grounding secondary wires of transformers. The Union Gas and Electric Company,

of Cincinnati, have ordered a thousand of these connectors, and their method of using them is to use a half-inch galvanized iron pipe fourteen feet long, seven feet of which is driven in the ground, the upper portion being stapled to the pole, at the upper end of which the Dossert joint is screwed. Connec-

tion is then made to the pipe with a number six ground wire by means of this joint. This joint can be thus used in all kinds of weather, as no soldering is necessary. They have found it a great advantage in outside work generally, and they have proven entirely satisfactory.

Voltax liquid compound, which, for the past year, has been coming into extensive use as a weather-proof paint, has just been specified by the Board of Education of New York City as a standard paint in Section 70, relating to painting and enameling on screens, radiators, coils and connections. Voltax will be used as a paint on pneumatic pipes, valves, canvas coverings on smoke pipes, grease extractors, economizer connections, feed water heaters, receiving tanks, boiler and incinerator fronts and on all fixtures, boilers, engines, pumps, blowers, foundations, steel bands and tanks set in the floors.

Mr. O. Baerwinkel, sales manager of the Excello Arc Lamp Company, of 24 East 21st street, New York City, has recently returned from an eight weeks' trip to the large factories in Germany, where the Excello arc lamp is manufactured. This factory, which is the largest exclusive arc lamp factory in the world, has one thousand men on its payroll, among whom are one hundred expert electricians and designers, requiring 1,500 horse-power to operate the machinery necessary in the manufacture of arc lamps. So rapidly has the demand for the product of this factory increased, that additions to the plant have been made every year for the past ten years. This factory now occupies a space equal to a New York city block with land in reserve for extensions equal to three additional city blocks.

One can gain some idea of the popularity of the Excello arc lamp in this country, when it is realized that this lamp was practically introduced about a year ago, when the first month's sale amounted to about forty lamps, and, up to the present over 3,500 have been sold every month, showing a large increase over the preceding month. This factory furnishes the bulk of the arc lamps used on the Continent. Mr. Baerwinkel is especially adapted to filling the position of sales manager of the Excello Arc Lamp Company, having had a world-wide experience in the introduction and sale of arc lamps

Before accepting his present position, Mr. Baerwinkel made a fifteen months' trip around the world in the interest of arc lamps, and during that period visited Egypt, Ceylon, India, China, Japan, Australia, New Zealand and Canada, and it may be truly said that the sun never sets on the territory which has been gained for this lamp. The Excello lamp is designed to burn carbons which give two distinct qualities of light. Those used for outside illumination give a very brilliant orange colored illumination, and make a most attractive light in front of show windows, theaters and stores for advertising purposes, and on account of its penetrating power, is especially valuable for piers, foundries and machine shops, where fog and misty atmosphere frequently prevails, the penetrating power of the orange rays being infinitely greater than those of the white light, which is mostly adopted for interior lighting, and which is also furnished by the Excello arc lamp by the use of a different make of carbon. Mr. H. M. Hirshberg, the agent for this lamp in the United States, has made several trips to the factory, and leaves in a few months for another trip, in the interest of the American business, which will soon form the largest branch of this big German plant.

The Columbia Incandescent Lamp Company, of St. Louis, Mo., on account of their rapidly increasing business in western Pennsylvania and eastern Ohio, has opened a branch office in the Penn Building, in Pittsburg, Pa., in which office a complete and well assorted stock of lamps will be carried for immediate shipment to their customers in that territory. This office will be in charge of Mr. J. D. O'Bryan.

Among the large contracts for gas and electric lighting fixtures recently installed by McKenney & Waterbury Co., 181 Franklin, corner Congress street, Boston, Mass., were the following: Mayflower Trust Building, Eliot National Bank Building, Huyler Candy Co.'s building, all of Boston; Holyoke Armory, Holyoke, Mass.; Quincy High School, Quincy, Mass.; Y. M. C. A. Building, Bennington, Vt. Messrs. McKenney & Waterbury Co. refer especially to the high standard of their work.

The New York City Interborough have just placed a large order with the Electric Cable Company, of 17 Battery Place, New York City, for flexible mesh rail bonds, which will hereafter be used exclusively by this company.

The increasing trade of the Mechanical Department of the Minneapolis Steel & Machinery Co. has made it imperative for them to add another large building of steel and brick construction to their already large plant.

It was only a few months ago that they had to double the capacity of their foundry. When the new building is completed, they will have a total of over 12 acres of floor space within a yard area of over 20 acres.

A company of Minneapolis men has given to that city an enterprise which is adding a new chapter to Minneapolis fame in all parts of the country. From now on, whenever men think of suction gas producers and gas engines, steam engines or steel construction on a large scale, they will think of Minneapolis.

In the short period of a year, since they have secured the right from Germany to build the Muenzel gas engine and suction gas producer, they have installed over thirty plants and have orders in the shops for a great many more. The demand for this modern power plant has demonstrated beyond a doubt that the power users of the United States were glad to install a gas power plant which had passed the experimental stage and was ready to work from the start.

It is such enterprises as this in the West that are making the Eastern people take notice.

The Chase-Shawmut Company, of Newburyport, Mass., have just put out to the trade a very neat flyer describing the Shawmut all copper ground connection clamp, which they manufacture.

This clamp, in view of the tendency of central stations to ground their secondary distributing systems, is a device which will prove of great service.

This clamp is made in two parts and when installed is locked in such a manner as to give the maximum contact upon the device upon which it is installed. It is simple in construction and requires only a pair of plyers to install it quickly and properly.

It is also used to a large extent for grounding the metal sheaths on cable, and for grounding conduit installations. For this latter purpose it is one of the simplest and cheapest devices on the market.

It is made in sizes from one-half to three inches and designed to take a number four wire.

The Northern Engineering Works, Crane Builders, Detroit, Mich., have furnished the plant of the Edison Sault Electric Co., Sault Ste. Marie, Mich., with a second 15-ton alternating current electric traveling Northern crane.

The city of Marshfield, Wisconsin, has practically finished the building for housing its new electric light and waterworks plant, and has now begun the installation of equipment.

Concrete foundations have been prepared for supporting two Allis-Chalmers reliance belted engines which will be used to drive two Allis-Chalmers alternating current generators, one of 225 kw. capacity, and the other of 100 kw. The engines are 14″ x 30″ and 18″ x 42″ respectively, and the generators are 60 cycle, 3-phase machines. Of these two units the smaller will be used to carry the station's day load, leaving the larger portion of the lighting load for the larger machine.

Three new 150-hp. boilers of the horizontal tubular type 72″ x 18′ will generate steam for the operation of the station.

In a sub-station, some distance away, the new pump will be installed seventeen feet below ground, by means of which water will be pumped into the stand pipe. The output from this new unit will be used to supplement the older pumping system, which is still to be kept in commission. The new pump will, however, supply enough water for all ordinary demands.

The new power house of the Edison Electric Company, of Los Angeles, Cal., on the Kern River, is nearing completion. The initial electric generating equipment provides for an output of some 20,000 kilowatts. The power will be transmitted by pole lines to Los Angeles and to Santa Barbara. Four General Electric Company 5,000 kilowatt, 3-phase, 50 cycle generators have been installed. These large machines are water wheel driven at 250 R. P. M., delivering current at a potential of 2,300 volts to the secondaries of the transformers. Each of the thirteen transformers has a capacity of 1,667 kilowatts, the primaries being arranged with taps to provide for Y connections at several different potentials, the highest being 75,000 volts and the lowest 33,000 volts. The secondary windings are arranged for delta connection at 2,300 volts.

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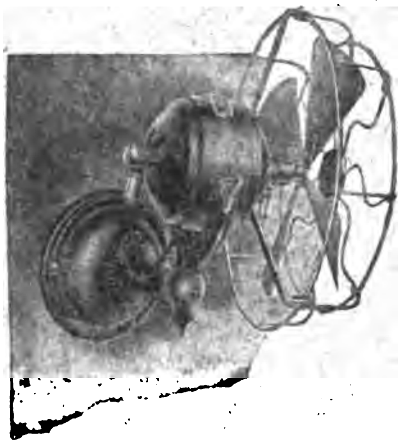
General Electric Company

Fan Motors and Flat Irons

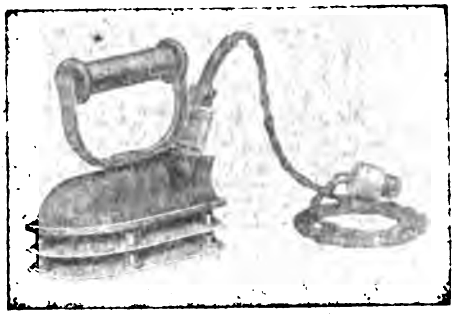
For Cooling and Heating Purposes



Twelve Inch Direct Current Wall Fan.

Central Station managers recognize that G. E. Fan Motors and heating devices will increase their sales of current during light load periods of the day.

Perfect construction in connection with proper electrical design, give the G. E. Fan Motors and heating devices the foremost place in the list of electric devices for the household and office.



Six-pound Flat Iron for General Household Use. Aluminum Bronze or Nickel Finish.

G. E. Fan Motors

G. E. Fan Motors for 1906 are noted for their electrical and mechanical improvements; efficiency, speed control, reliability and breeze without noise.

This company furnishes a most complete line comprising, desk, wall bracket, ceiling and telephone booth fans and ventilating outfits for alternating as well as direct current.

Motors can be supplied for various voltages and frequencies to meet every requirement.

The G. E. Flat Iron

G. E. Flat Iron, the iron that always stays hot under the hardest work because the heat flows rapidly to the work and not into the air. Designed for efficient heat transmission.

Connection—A porcelain detachable plug with substantial contacts. Six Pound Flat Irons for general work; smaller ones for the sewing-room and travelers.

Always clean, convenient and inexpensive.

Your stock will be incomplete unless G. E. Fan Motors and heating devices are included.

Principal Office: SCHENECTADY, N. Y.

974

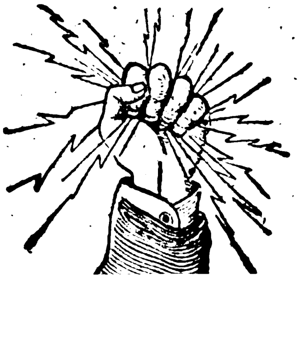
New York Office:
44 Broad Street

Sales Offices
in All Large Cities

The Central Station

DEVOTED EXCLUSIVELY TO THE INTERESTS OF ELECTRIC LIGHTING AND POWER STATIONS

Vol. 6. No. 9. MARCH, 1907. One Dollar a Year.



WESTINGHOUSE LAMPS

**THE NAME IS
YOUR
GUARANTEE**

**ALL TYPES
ALL CANDLES
ALL VOLTAGES**

WESTINGHOUSE LAMP CO.

510 WEST 23d STREET, NEW YORK

Sales Offices:

Atlanta
Baltimore
Boston
Buffalo
Butte
Salt Lake City
Charlotte
Chicago
Cincinnati
Cleveland
Columbus
San Francisco
Dallas
Denver
Detroit
Joplin
Kansas City
Seattle
Los Angeles
Louisville
Milwaukee
Minneapolis
New Orleans
Syracuse
New York
Philadelphia
Pittsburg
Richmond
St. Louis

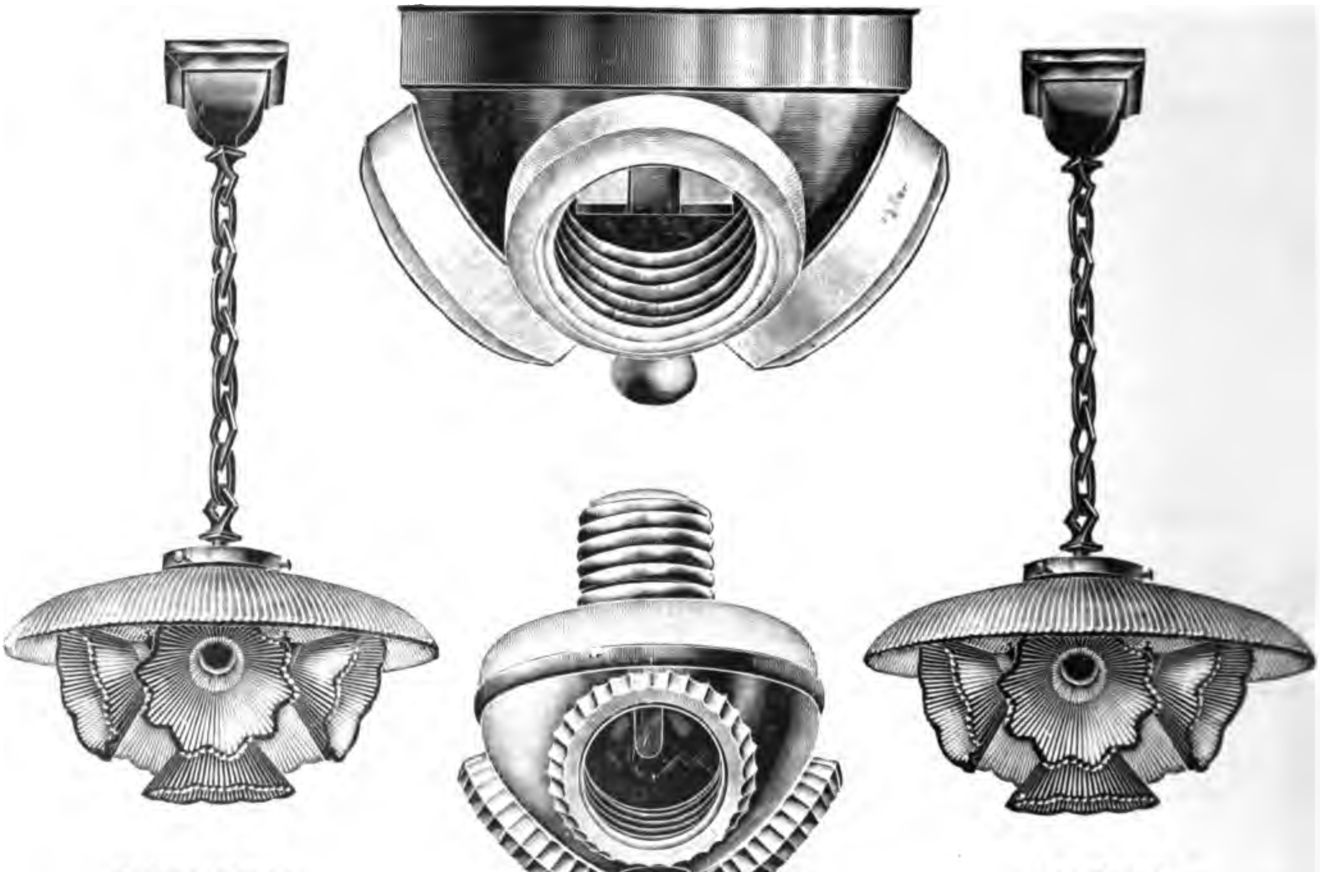
Factories:

**512-534 West 23d Street, New York, N. Y.
and Bloomfield (Watsessing) New Jersey**

DALE'S
WIRELESS CLUSTERS

Labor Saving

The First Wireless Cluster Put on the Market by us in 1898



HIGHEST AWARD

ST. LOUIS EXPOSITION

THE DALE COMPANY

9th Ave., 13th and Hudson Streets

NEW YORK CITY

Established 1897

Write for Catalogs

REPUTATION

is a created estimation in the mind of another.

CHARACTER

is the creative force which maintains that reputation.

PHOENIX INNERS

have an honorable heredity to a well established name. By consistent progress in every essential necessary to the making of a perfect globe, the **Phoenix** secures accumulating prosperity. The **Phoenix** is a square-dealing competitor, rises by merit alone and not by envious aspersion of rivals.

Its claims are positive. Comparisons belong to others. Thus it comes about that the **"Phoenix Inner"** has a host of friends among careful buying Central Stations. The number of **"Phoenix Inners"** sold constantly increases because of the loyalty of friends secured by merit.

Thus the foundation of continuous success is laid upon the solid rock of complete confidence.

PHOENIX INNERS

have all the desirable qualities of a perfect globe.

They possess real merit and give continuous satisfaction.

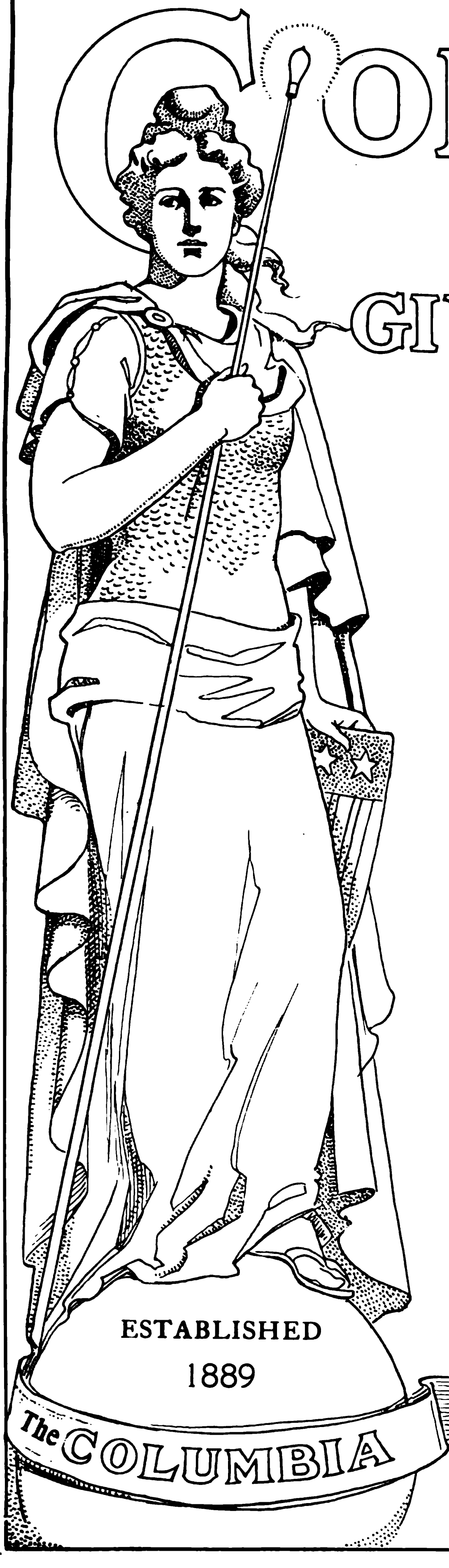
Write for our inner globe proposition.

Catalogues upon request.

THE PHOENIX GLASS COMPANY

NEW YORK PITTSBURGH CHICAGO

COLUMBIA LAMPS GIVE MOST LIGHT



Columbia carbon filament lamps will give most light because they give a much higher spherical C. P. than other types of lamps.

Columbia GEM metalized filament lamps in the 50 watt line as well as the high C. P. high efficiency line are giving uniform satisfaction.

Write us for Bulletins on metalized filament and Tantalum lamps.

Correspondence solicited.

BRANCH OFFICES:

NEW YORK, Taylor Bldg., No. 39-41 Cortlandt St.
PHILADELPHIA, No. 1221 Real Estate Trust Bldg.
CHICAGO, No. 264-270 Fifth Ave.
PITTSBURG, No. 705 Penn Bldg.
MEMPHIS, No. 26 Randolph Bldg.

ESTABLISHED
1889

The COLUMBIA INCANDESCENT LAMP CO.

ST. LOUIS MO.

"ADVERTISE WHEN YOU

We have just secured the largest single installation of *Gem* Lamps in the *World*.

The new Pierce Office Building, St. Louis, Mo.

In this building there are 7,614 sockets. 6,000 of these sockets contain 50 watt, 20 c. p. G. I. Gem Lamps.

1,014 in the lobbies contain 50 c. p. G. I. Gem High Efficiency Units. This ought to speak for quality, because every Lamp Company in the United States tried for the Contract *and we got it.*

N. B. Good Agents Wanted in Territories Not Covered.

GENERAL INCANDESCENT LAMP CO.

1811 East 45th Street,

CLEVELAND, OHIO

HAVE SOMETHING TO SAY"

(Motto—General Incandescent Lamp Co.)

We were the last company to push these high efficiency Lamps, preferring to wait until we were sure of their being absolutely satisfactory.

We are now *sure*; and carry a large stock.

So do our agents—write to the nearest.

(Notice who our agents are—the best in the country.)

M. B. AUSTIN & COMPANY, 133-141 West Jackson Boulevard,	CHICAGO, ILL.
CHRISTOPHER ELECTRIC CO.,	BEAUMONT, TEXAS
COAST ELECTRIC COMPANY, 312-314 San Pablo Avenue,	OAKLAND, CAL.
CROSBY, CRAFT & CO., 423 Williamson Building,	CLEVELAND, O.
FRANK ADAM ELECTRIC COMPANY, 904-914 Pine Street,	ST. LOUIS, MO.
HENDRIE & BOLTHOFF MFG. & SUPPLY CO. 1635 17th St.,	DENVER, COLO.
JACKSON & EARLE,	STOCKTON, CAL.
HOBSON ELECTRIC COMPANY, 172-174 Commerce Street,	DALLAS, TEXAS
MOUNTAIN STATE ELECTRICAL CO., 911-913 Market St.,	WHEELING, W. VA.
W. F. IRISH ELECTRIC CO., 60 Cortlandt St.,	NEW YORK, N. Y.
ROYSE ELECTRIC COMPANY, 125 S. Meridian St.,	INDIANAPOLIS, IND.
SOUTHERN ELECTRIC COMPANY, 423 North Calvert St.	BALTIMORE, MD.

LOOK FOR THE LICENSE LABEL IN THE STEM

N. B. Good Agents Wanted in Territories Not Covered.

GENERAL INCANDESCENT LAMP CO.

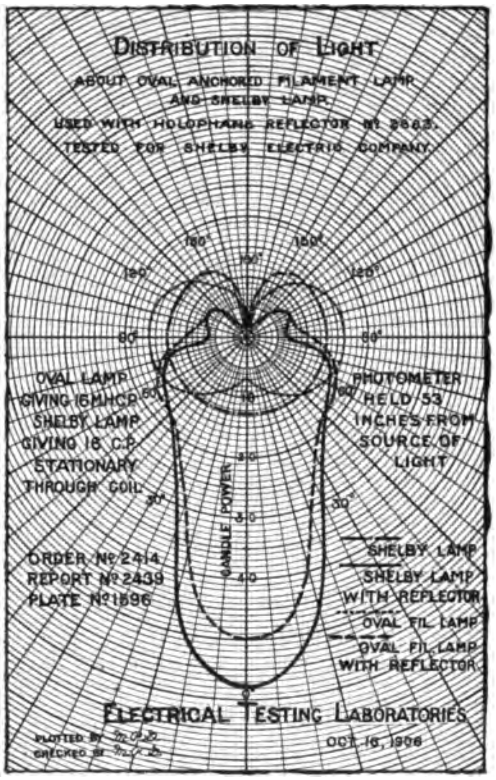
San Francisco Office,

403-406 Atlas Building

THE QUESTION OF THE DAY

WHERE IS THE LIGHT MOST VALUABLE ?

NOTE: Lamps taking same current, giving equal spherical candle power, have the same life



The above shows results of test made of Shelby Useful Light Lamps against Oval Filament Lamps. Both lamps had the same spherical candle power, same current consumption, same life, first cost the same. The Shelby Type gives

70 Per Cent. More Useful Light

Everyone concedes that the light below the lamp is the *useful light*. Send us your next order.

THE SHELBY ELECTRIC COMPANY

SHELBY, OHIO, U. S. A.

BRANCHES:

Boston, Baltimore, Detroit, Indianapolis, New York, Pittsburg, Louisville, Portland, Philadelphia, Cleveland, St. Louis, Atlanta, Chicago, Cincinnati, San Francisco, Washington, D. C.

CO-OP

BE
A
CO-OPERATOR

IF A SELLING PLAN were presened to you which you believed would yield a greater return of business per unit of money and time expended on it than you can now secure, you would lose no great amount of time in adopting it, would you?

If such a sales plan were directed toward increasing your sales as against your competitors in the electrical field for business either already existing or from the natural growth—it would merely be one of many such plans which you are daily figuring on.

BUT IF SUCH A SALES PLAN concerned itself with creating new and more business which otherwise would not exist—if it was directed along broader and more effective lines than you can afford to undertake in educating the public to the largest use of electrical service for light, heat and power, etc.—if this were to be brought about through concerted and concentrated effort and money of all the men in the business, eliminating the object of profit from its operation and competition among ourselves in its execution—it certainly would merit your careful consideration, would it not? (See next page.)

CO-OPERATIVE ELECTRICAL
CLEVELAND

— ERATION

BE
A
CO-OPERATOR

THE CO-OPERATIVE ASSOCIATION presents just such plans.

Their merit has been passed upon favorably by special committees representing all the branches of the electrical business, manufacturers, contractors, jobbers and central stations.

$50,000 has been spent in executing some of them. $75,000 additional has been underwritten in the last 60 days, and the complete plans call for an ultimate expenditure of $360,000 annually, which is being underwritten in the form of membership stock subscriptions from all branches of the business.

THIS ASSOCIATION opens up the opportunity and supplies the organization and the plans for commercial team work—co-operation along original, progressive and effective lines for cultivating and increasing the ultimate market—the great money-spending public.

This is our common market, whether we reach it direct or through and against one another.

Take note of the importance attached to this proposition at the forthcoming Convention of the National Electric Light Association, Washington, June 4th to 7th, 1907.

You ought to be numbered among the Co-operators. We will welcome a chance to tell you the why, when, how, what and how much of the proposition.

Write us for the Association's Constitution and By-Laws—Edition de Luxe.

Be-a-co-operator.

— DEVELOPMENT ASSOCIATION
— OHIO

"O.K." Ground Clamps

A Perfect Contact with the Pipe

Made of stamped spring copper, are the easiest to install and make the best contact of any ground clamp on the market. Protection to life and property demands that secondary house wires, iron conduit and lead cable sheathes be grounded.

WRITE US FOR SAMPLE.

Approved by the Underwriter's National Electric Association

A Perfect Contact with the Grounding Wire

OKONITE

TRADE MARK
REG. U.S. PATENT OFFICE

If you cannot control the course of the electric current, the value of even the best electrical apparatus is lost.

Use OKONITE and you will secure the service you have a right to expect from an Insulated Wire.

Pettingell-Andrews Company

Boston, Mass.

The Standard For Rubber Insulation

Muenzel Gas Engine & Suction Gas Producer Power Plant

Muenzel Gas Engine and Suction Gas Producer Power Plant.

GUARANTEED
a saving of from
50% to 75%
IN
YOUR FUEL BILLS
AND
OPERATING
EXPENSES

One pound of coal per
H. P. per hour.

CITY OF RANDOLPH

To Whom It May Concern: RANDOLPH, NEB., Feb. 7, 1907.

Be it known that at the invitation of the Minneapolis Steel & Machinery Co., I have this day inspected the 85 H.P. "Muenzel" Gas Engine and Suction Gas Producer installed for the City of Randolph, Neb., Municipal Electric Light Plant, and beg to state that in every respect it has exceeded my expectations both as to workmanship, design and economical operating cost. It gives a most uniform and steady light on the Arc and Incandescent service, and the voltmeter shows scarcely any variation. A silver dollar set on edge on the cylinder remained upright.

I have examined four other different makes of gas engines and producers, both vertical and horizontal, and without reservation I pronounce the Muenzel the very best.

(Signed) J. H. MAST, Consulting Engineer.

Minneapolis Steel & Machinery Co., Minneapolis, Minn.

THE ANDERSON

Cushioned Non-Return Valves

"Life and Property Insurance Valves"

THEY will automatically cut off a boiler in case of accident to the boiler, such as the bursting of a tube, and will also act as a SAFETY stop to prevent steam being turned into a cold boiler, which also means a safeguard for men working inside.

Is an ***Automatic Stop Valve***, also a ***Hand Stop Valve***, all in one.

The heaviest line of Automatic Valves and Traps ever presented to users.

ANDERSON PATENT FLOAT VALVE

"Simply Has No Equal"

The Valve with an Absolute Guarantee Cushioned in opening and closing.

For high and low pressure Absolutely controls the water level in tanks or reservoirs. Instantly adjusted to operate quick or slow, as desired. The upper portion of body being lined with bronze, also the valve or piston being solid bronze, makes the valve indestructible. Firms that are using them say, " their equal is not made."

GOLDEN-ANDERSON VALVE SPECIALTY CO., 1012 Fulton Bldg., Pittsburg, Pa.

THE CENTRAL STATION DIRECTORY
OF MANUFACTURERS OF STANDARD APPARATUS AND SUPPLIES
REQUIRED IN THE OPERATION AND MAINTENANCE OF ELECTRIC LIGHT & POWER STATIONS

AMMETERS.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.
Weston Electrical Inst. Co., Newark, N. J.

ARRESTERS, Lightning.
General Electric Co., Schenectady, N. Y.
Lord Electric Co., New York, N. Y.
Westinghouse Elec. & Mfg. Co., Pittsburg.

BOARDS, Switch and Panel.
Frank Adam Electric Co., St. Louis, Mo.
General Electric Co., Schenectady, N. Y.
Trumbull Elec. Mfg. Co., Plainville, Conn.
Westinghouse Elec. & Mfg. Co., Pittsburg,

BOILERS, Water Tube.
Babcock & Wilcox Co., New York, N. Y.
Murray Iron Works Co., Burlington, Ia.

BOOKS, Technical.
D. Van Nostrand Co., New York, N. Y.

CARBONS, Arc Lamp.
Hugo Reisinger, New York, N. Y.

CHANDELIERS, Gas and Electric.
Holophane Co., New York, N. Y.
Horn & Brannen Mfg. Co., Phila., Pa.

CIRCUIT BREAKERS.
The Cutter Co., Phila., Pa.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

COMPOUNDS, Insulating.
The Electric Cable Co., New York, N. Y.

CONDUIT, Interior (Iron and flexible tube).
American Circular Loom Co., Chelsea, Mass.

CONDUIT, Underground.
G. M. Gest, New York and Cincinnati.
Standard Vitrified Conduit Co., New York, N. Y.

CONNECTORS, Solderless, for Cables.
Dossert & Co., New York.

COVERINGS, Boiler and Pipe.
Robert A. Keasbey Co., New York, N. Y.

CRANES, Electric.
Northern Engineering Wks., Detroit.

DECORATIVE LIGHTING, Temporary.
Elblight Co., New York.
General Electric Co., Schenectady.

ENGINEERS, Consulting and Constructing.
Land-Wharton Co., Philadelphia, Pa.
George T. Hanchett, New York, N. Y.

ENGINES, Gas.
Minneapolis Steel & Mach. Co., Minneapolis, Minn.

ENGINES, Steam.
Allis-Chalmers Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Minneapolis Steel & Mach. Co., Minneapolis, Minn.
Murray Iron Works Co., Burlington, Ia.

FEED WATER HEATERS.
Murray Iron Works Co., Burlington, Ia.

FIXTURES, Electric, Gas and Combination.
The Dale Co., New York.
Horn & Brannen Mfg. Co., Phila., Pa.

FUSES and Fuse Devices.
Chase-Shawmut Co., Newburyport, Mass.
Chicago Fuse Wire & Mfg. Co., Chicago.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

GAS PRODUCERS, for Gas Engines.
Minneapolis Steel & Machy. Co., Minneapolis, Minn.

GENERATORS, A. C. and D. C.
Allis-Chalmers Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Warren Electrical Mfg. Co., Sandusky, O.
Western Electric Co., Chicago & New York.
Westinghouse Elec. & Mfg. Co., Pittsburg.

GLOBES, Inner and Outer, Arc Lamp.
Fostoria Glass Splty. Co., Fostoria, O.
Phoenix Glass Co., New York and Pittsburg.

GLOBES AND SHADES, Electric and Gas.
Holophane Co., New York, N. Y.
Phoenix Glass Co., New York and Pittsburg.

GROUND CONNECTION CLAMPS.
Chase-Shawmut Co., Newburyport, Mass.
Novelty Electric Co., Philadelphia, Pa.

HEATING AND COOKING APPARATUS.
General Electric Co., Schenectady, N. Y.
Simplex Electric Heating Co., Cambridge, Mass.

INSTRUMENTS, Electrical Testing.
Weston Electrical Instrument Co., Newark, N. J.

INSULATORS, Tree.
Dunton & Field, Cambridge, Mass.

LAMPS, Arc.
Excello Arc Lamp Co., New York.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

LAMPS, Incandescent.
Bryan-Marsh Co., New York, N. Y.
Buckeye Electric Co., Cleveland, O.
Columbia Inc. Lamp Co., St. Louis.
Downward Light Electric Co., New York.
General Electric Co., Harrison, N. J.
General Inc. Lamp Co., Cleveland.
New York & Ohio Co., Warren, O.
Shelby Electric Co., Shelby, O.
Sunbeam Incandescent Lamp Co., New York
Westinghouse Lamp Co., New York.

LAMPS, Renewed Incandescent.
Re-New Lamp Co., Boston, Mass.

METERS.
Duncan Electric Mfg. Co., Lafayette, Ind.
General Electric Co., Schenectady, N. Y.
Helios Mfg. Co., Philadelphia, Pa.
Westinghouse Elec. & Mfg. Co., Pittsburg.

MOTORS, A. C and D. C.
General Electric Co., Schenectady, N. Y.
Warren Electrical Mfg. Co., Sandusky, O.
Western Electric Co., Chicago & New York.
Westinghouse Elec. & Mfg. Co., Pittsburg.

MOTORS, Fan.
General Electric Co., Schenectady, N. Y.
Warren Electrical Mfg. Co., Sandusky, O.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Western Electric Co., Chicago & New York.

MOULDING Metal, "Lutz."
American Circular Loom Co., Chelsea, Mass.

OILING SYSTEMS, Continuous.
Pittsburg Gage & Supply Co., Pittsburg, Pa.

OILS, Lubricating.
E. H. Kellogg & Co., New York, N. Y.

PANEL BOARDS.
Frank Adam Electric Co., St. Louis, Mo.
Chase-Shawmut Co., Newburyport, Mass.
General Electric Co., Schenectady, N. Y.
Trumbull Electric Mfg. Co., Plainville, Conn.

RECEPTACLES.
General Electric Co., Schenectady, N. Y.
Hart Manufacturing Co., Hartford, Conn.
Trumbull Electric Mfg. Co., Plainville, Conn.

REFLECTORS, Show-windows, Churches and Halls.
Gillinder & Son, Philadelphia, Pa.
Holophane Co., New York, N. Y.

REGULATORS, Damper.
Paterson Mfg. Co., Baltimore, Md.

REGULATORS, Voltage.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., Pittsburg.

RHEOSTATS.
Cutler-Hammer Mfg. Co., Milwaukee, Wis.

SEPARATORS, Steam and Oil.
Harrison Safety Boiler Works, Phila., Pa.

SOCKETS, Incandescent Lamp, all styles.
Bryant Electric Co., Bridgeport, Conn.
General Electric Co., Schenectady, N. Y.

STARTERS, Motor.
Cutler-Hammer Mfg. Co., Milwaukee, Wis.

STORAGE BATTERIES.
General Storage Battery Co., New York, N. Y.

SUPPLIES, Eectrical.
Stuart-Howland Co., Boston, Mass.
Western Electric Co., Chicago & New York.

SWITCH BOARDS.
Frank Adam Electric Co., St. Louis, Mo.
Chase-Shawmut Co., Newburyport, Mass.
General Electric Co., Schenectady, N. Y.
Trumbull Elec. Mfg. Co., Plainville, Conn.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

SWITCH BOXES, Iron, Service.
Frank Adam Electric Co., St. Louis, Mo.
Trumbull Elec. Mfg. Co., Plainville, Conn.

SWITCH BOXES, Metal.
The Cutter Co., Philadelphia, Pa.
General Electric Co., Schenectady, N. Y.
Hart Manufacturing Co., Hartford, Conn.
Trumbull Electric Mfg. Co., Plainville, Conn.

SWITCHES, Automatic Time.
The Ballou-Hutchins Elec. Co., Providence, R. I.
General Electric Co., Schenectady, N. Y.
Hartford Time Switch Co., New York, N. Y.

SWITCHES, High Potential Oil Break.
Frank Adam Electric Co., St. Louis, Mo.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

SWITCHES, Knife.
Frank Adam Electric Co., St. Louis, Mo.
General Electric Co., Schenectady, N. Y.
Trumbull Electric Mfg. Co., Plainville, Conn.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

SWITCHES, Snap and Flush.
The Cutter Co., Philadelphia, Pa.
General Electric Co., Schenectady, N. Y.
Hart Manufacturing Co., Hartford, Conn.

TAPE, Insulating.
American Electrical Works, Providence, R. I.
The Electric Cable Co., New York, N. Y.
The Okonite Co., New York, N. Y.

TRANSFORMERS.
General Electric Co., Schenectady, N. Y.
Warren Electrical Mfg. Co., Sandusky, O.
Westinghouse Elec. & Mfg. Co., Pittsburg.

TURBINES, Steam.
Allis-Chalmers Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Westinghouse Machine Co., Pittsburg, Pa.

VOLTMETERS, (See Ammeters).

WIRE, Magnet.
American Electrical Works, Providence, R. I.
The Electric Cable Co., New York, N. Y.

WIRES AND CABLES.
American Electrical Works, Providence, R. I.
The Electric Cable Co., New York, N. Y.
General Electric Co., Schenectady, N. Y.
The Okonite Co., New York, N. Y.
Phillips Insulated Wire Co., Pawtucket, R. I.
John A. Roebling's Sons' Co., Trenton, N. J.

WIRES AND CABLES, Iron and Steel.
American Electrical Works, Providence, R. I.
John A. Roebling's Sons' Co., Trenton, N. J.

ALLIS-CHALMERS CO.

MILWAUKEE, WIS., U. S. A.

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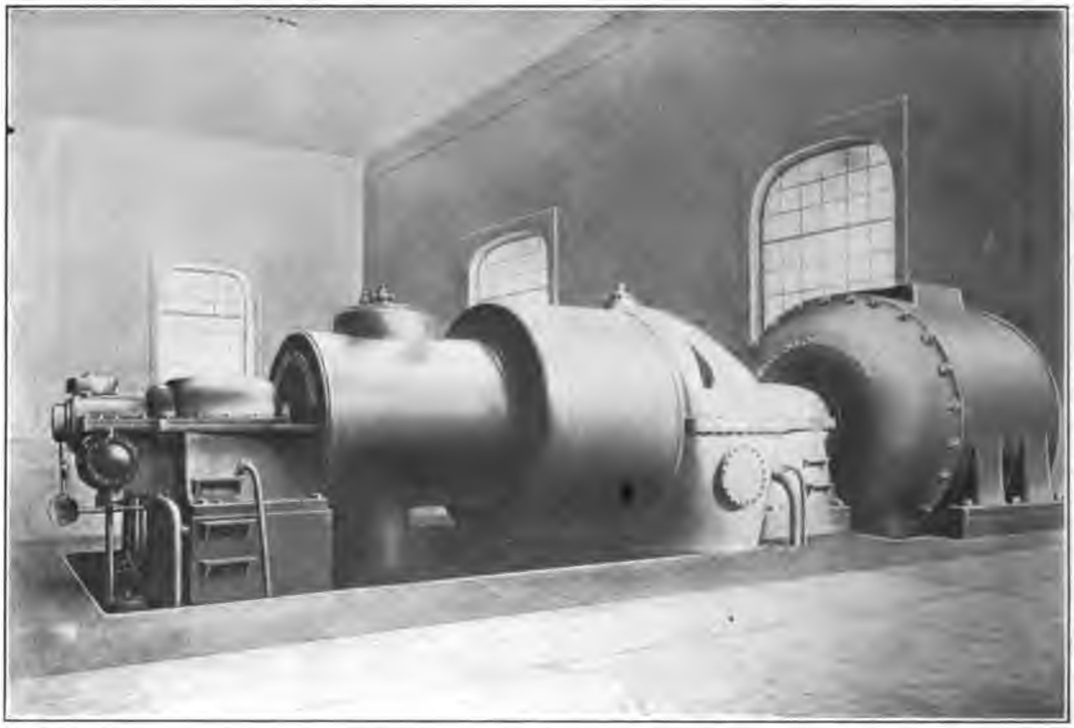

IN the 6000 K. W. Unit shown by the accompanying illustration, as in all of the steam Turbines built by Allis-Chalmers Company, are incorporated the channel-shaped shrouds, protecting the ends of the blading from injury; machine-cut slots in the foundation rings, insuring absolutely accurate spacing of the blades, and improved balance pistons, reducing the diameter of the cylinder and preventing distortion under varying temperatures. All three features of construction are patented and controlled by us, in the United States, Canada and Mexico. For further details see our Bulletin 1054.

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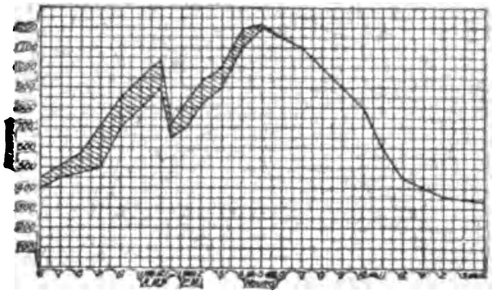
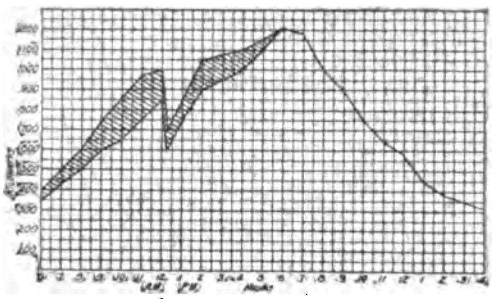
General Electric Company

What GE Flatirons have done



Shaded area shows improvement of day-load curve made by GE flatiron in a city of 25,000. One hundred irons in use all day in a factory and five hundred irons distributed in residences.



Shaded area shows improvements of a Tuesday load curve in a city of 30,000 made by 500 GE flatirons on lighting circuits in residence districts.

What GE electric flatirons have done indicates what they will do in hundreds of other cities soon

The GE flatiron is the easiest electric heating device to introduce because it converts the most dreaded summer ordeal in the household into a pleasant and easily performed task. The GE iron keeps every friend after introduction.

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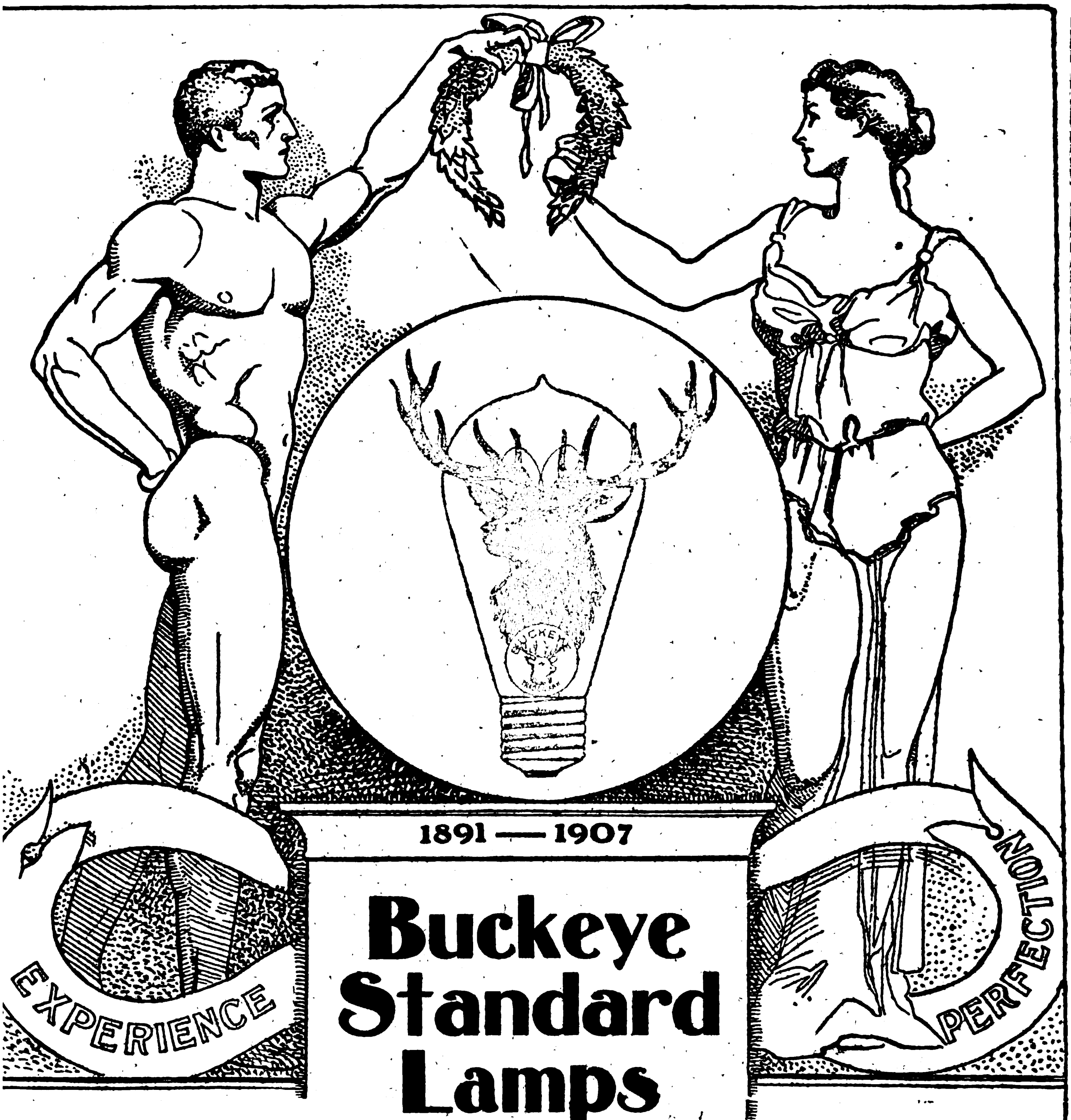

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